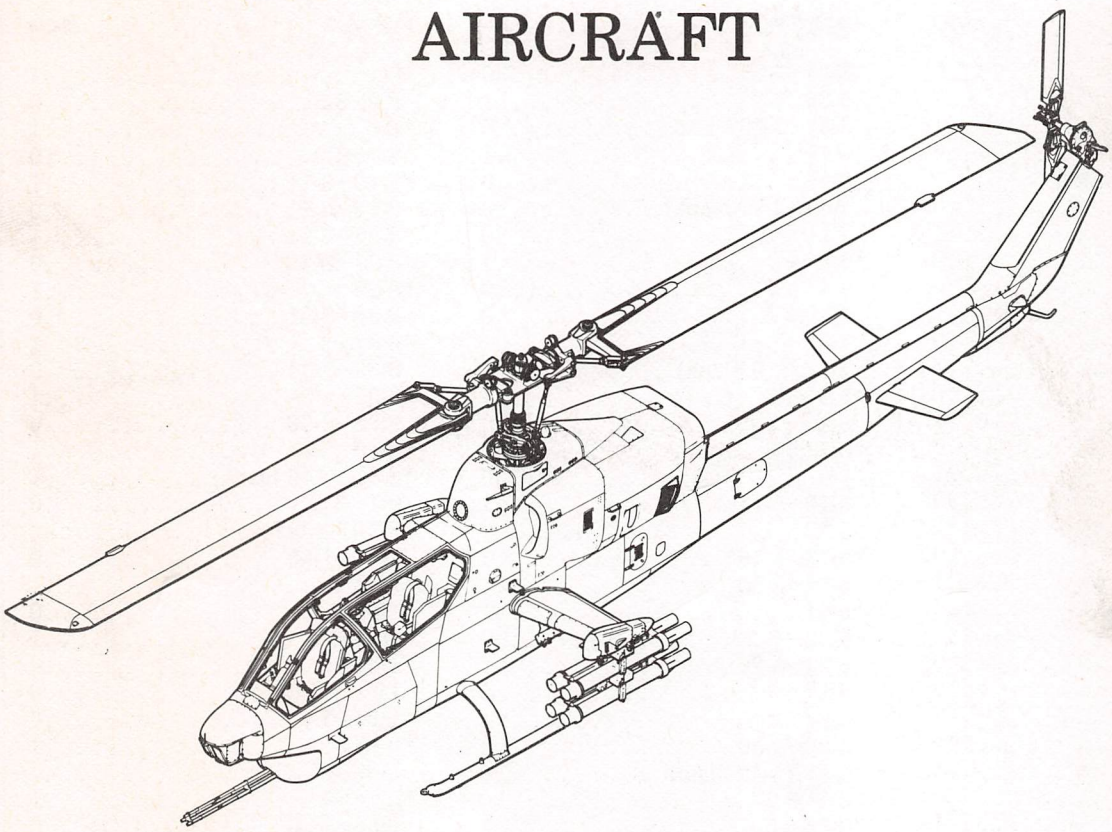
NAVAIR 01-H1AAB-1

PRELIMINARY

NATOPS FLIGHT MANUAL

NAVY MODEL

AH-1T (TOW) AIRCRAFT



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ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS
AND UNDER THE DIRECTION OF THE COMMANDER.
NAVAL AIR SYSTEMS COMMAND

THE AIRCRAFT 1
INDOCTRI-NATION 2
NORMAL PROCEDURES 3
FLIGHT CHARAC 4
EMER PROCEDURES 5
ALL-WEA OPERATION 6
COMM PROCEDURES 7
WEAPONS SYSTEMS 8
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INDEX & FOLDOUTS

1 AUGUST 1980
Change 1 — 15 February 1983

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INTERIM CHANGE SUMMARY

The following Interim Changes have been cancelled or previously incorporated in this manual:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1—6, 8	

The following Interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE
7	Airspeed Limits.
9	Rotor Brake Limits.
10	Impending Transmission Failure.
11	Mast Bumping.
12	Maneuvering Flight.

Interim Changes Outstanding — To be maintained by the custodian of this manual:

INTERIM CHANGE NUMBER	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE

SUMMARY OF APPLICABLE TECHNICAL DIRECTIVES

Information relating to the following recent technical directives has been incorporated in this manual

CHANGE NUMBER	DESCRIPTION	DATE INC. IN MANUAL	VISUAL IDENTIFICATION

Information relating to the following recent technical directives will be incorporated in a future change

CHANGE NUMBER	DESCRIPTION	VISUAL IDENTIFICATION

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft accident rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, Commanding Officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3510.9 series, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and may be carried in Naval Aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

W. L. McDONALD
Vice Admiral, USN
Deputy Chief of Naval Operations
(Air Warfare)

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FOREWORD

SCOPE

The NATOPS Flight Manual is issued by the authority of the Chief of Naval Operations and under the direction of Commander, Naval Air Systems Command in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) Program. This manual contains information on all aircraft systems, performance data, and operating procedures required for safe and effective operations. However, it is not a substitute for sound judgement. Compound emergencies, available facilities, adverse weather or terrain, or considerations affecting the lives and property of others may require modification of the procedures contained herein. Read this manual from cover to cover. It's your responsibility to have a complete knowledge of its contents.

APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

NAVAIR 01-H1AAB-1B (Pocket Checklist)
NEW NAVAIR 01-H1AAB-1F (Functional Checkflight Checklist)

HOW TO GET COPIES

Each flight crewmember is entitled to personal copies of the NATOPS Flight Manual and appropriate applicable publications.

Automatic Distribution

To receive future changes and revisions to this manual or any other NAVAIR aeronautical publication automatically, a unit must be established on an automatic distribution list maintained by the Naval Air Technical Services Facility (NATSF). To become established on the list or to change existing NAVAIR publication requirements, a unit must submit the appropriate tables from NAVAIR 00-25DRT-1 (Naval Aeronautic Publications Automatic Distribution Requirement Tables) to NATSF, Code 321, 700 Robbins Avenue, Philadelphia, PA 19111. Publication requirements should be reviewed periodically and each time requirements change, a new NAVAIR 00-25DRT-1 should be submitted. NAVAIR 00-25DRT-1 only provides for future issues of basic, changes, or revisions and will not generate supply action for the issuance of publications from stock. For additional instructions, refer to NAVAIRINST 5605.4 series and Introduction to Navy Stocklist of Publications and Forms NAVSUP Publication 2002 (S/N 0535-LP-004-0001).

Additional Copies

Additional copies of this manual and changes thereto may be procured by submitting DD Form 1348 to NAVPUBFORMCEN Philadelphia in accordance with Introduction to Navy Stocklist of Publications and Forms NAVSUP Publication 2002.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with OPNAVINST 3510.9 series.

CHANGE RECOMMENDATIONS

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with OPNAVINST 3510.9 series.

Routine change recommendations are submitted directly to the Model Manager on OPNAV Form 3500-22 shown on the next page. The address of the Model Manager of this aircraft is:

Commanding Officer
HMA-269, MAG-29, MCAS (H) New River
Jacksonville, N.C. 28545
(Attn: NATOPS)

Change recommendations of an URGENT nature (safety of flight, etc.,) should be submitted directly to the NATOPS Advisory Group Member in the chain of command by priority message.

YOUR RESPONSIBILITY

NATOPS Flight Manuals are kept current through an active manual change program. Any corrections, additions, or constructive suggestions for improvement of its content should be submitted by routine or urgent change recommendation, as appropriate, at once.

NATOPS FLIGHT MANUAL INTERIM CHANGES

Flight Manual Interim Changes are changes or corrections to the NATOPS Flight Manuals promulgated by CNO or NAVAIRSYSCOM. Interim Changes are issued either as printed pages, or as a naval message. The Interim Change Summary page is provided as a record of all interim changes. Upon receipt of a change or revision, the custodian of the manual should check the updated Interim Change Summary to ascertain that all outstanding interim changes have been either incorporated or canceled; those not incorporated shall be recorded as outstanding in the section provided.

CHANGE SYMBOLS

NEW Revised text is indicated by a black vertical line in either margin of the page, adjacent to the affected text, like the one printed next to this paragraph. The change symbol identifies the addition of either new information, a changed procedure, the correction of an error, or a rephrasing of the previous manual. NEW

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "WARNINGS", "CAUTIONS", and "NOTES" found through the manual.

WARNING

An operating procedure, practice, or condition, etc., which may result in injury or death if not carefully observed or followed.

CAUTION

An operating procedure, practice, or condition, etc., which may result in damage to equipment if not carefully observed or followed.

NOTE

An operating procedure, practice, or condition, etc., which is essential to emphasize.

WORDING

The concept of word usage and intended meaning which has been adhered to in preparing this Manual is as follows:

NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV FORM 3500/22 (5-69) 0107-722-2002 DATE

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (originator)	Unit
TO (Model Manager)	Unit

Complete Name of Manual/Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph

Recommendation (be specific)

☐ CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title

Address of Unit or Command

TO BE FILLED IN BY MODEL MANAGER *(Return to Originator)*

FROM	DATE

TO

REFERENCE
(a) Your Change Recommendation Dated _____

☐ Your change recommendation dated _____ is acknowledged. It will be held for action of the review conference planned for _____ to be held at _____.

☐ Your change recommendation is reclassified URGENT and forwarded for approval to _____ by my DTG _____

/S/ _____ MODEL MANAGER. _____ AIRCRAFT

"Shall" has been used only when application of a procedure is mandatory.

"Should" has been used only when application of a procedure is recommended.

"May" and "need not" have been used only when application of a procedure is optional.

"Will" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

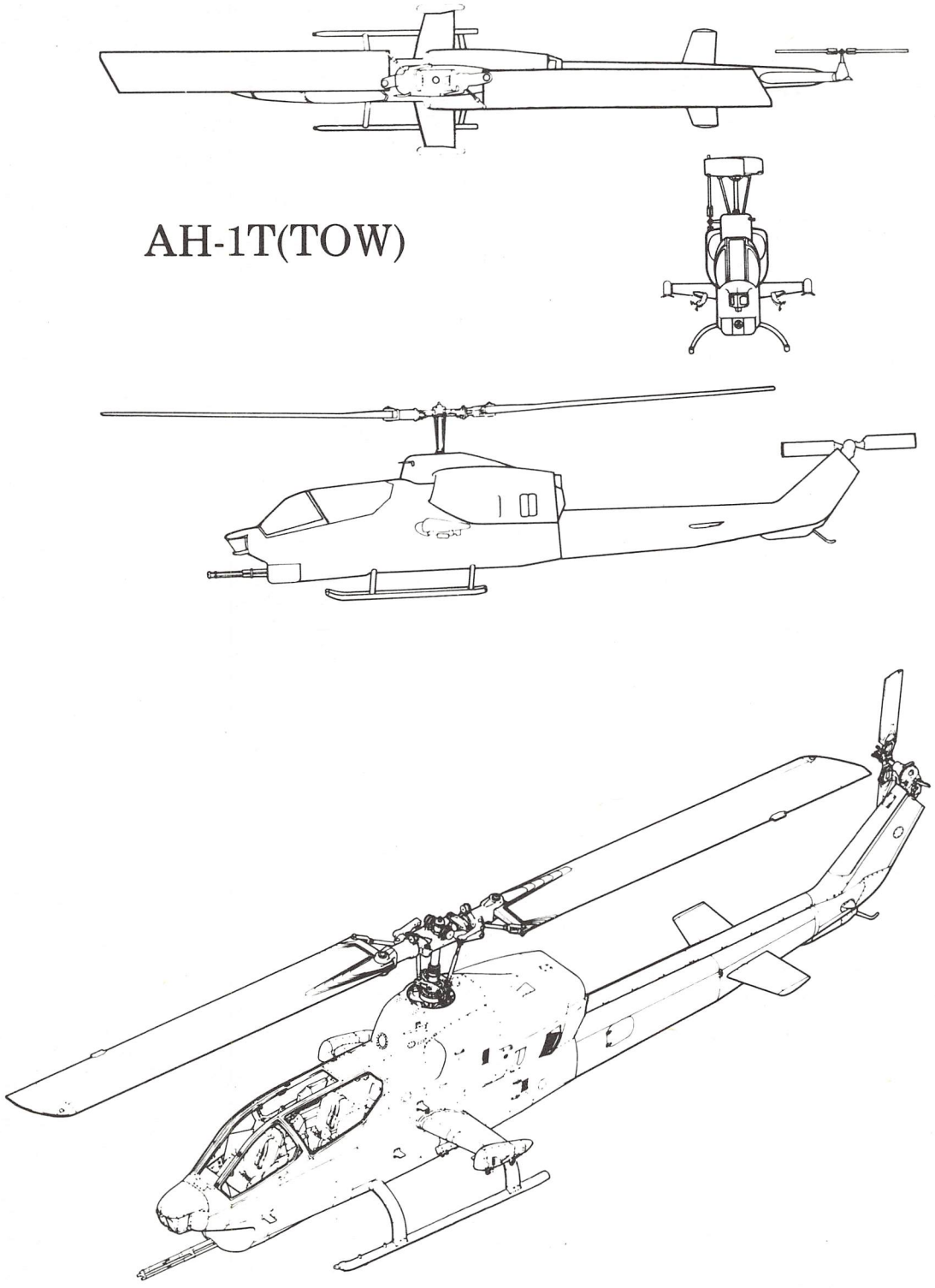


Figure 1-0

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PART 1 — HELICOPTER AND ENGINES

HELICOPTER.

The AH-1T is a tandem seat, two place (pilot and copilot/gunner) twin engine attack helicopter manufactured by Bell Helicopter Textron. It is an aggressive, high speed helicopter designed and built around the fighting mission. The mission profiles completely cover the air to ground environment with multiple weapon suppressive fire. The helicopter is maneuverable, capable of low altitude, high speed flight and self protection in hostile air and ground battle situations. Its primary mission is search and target acquisition, reconnaissance by fire, multiple weapon fire support and troop helicopter support. The helicopter is capable of performing this mission from prepared or unprepared areas, during day or night flying and navigating by dead reckoning or by use of radio aids to navigation.

ENGINES.

The T400-WV-402 engine is a twin power section turboshaft engine consisting of two identical free-turbine turboshaft power sections driving a single output shaft through separate halves of a common combining gearbox. The engine develops 1970 shaft horsepower at 100 percent torque and 100 percent RPM.
The engine is manufactured by Pratt & Whitney of West Virginia.

NOTE

To enable the use of standard terminology in this manual, the individual power sections will be referred to as engine 1 (left) and engine 2 (right).

SPEED RANGE.

The speed range of this helicopter, clean configuration, is 0 to 190 knots based on standard day conditions (29.92 inches of mercury, 15 degrees celsius at sea level).

TAKEOFF GROSS WEIGHT.

The maximum gross weight for takeoff is 14,000 pounds.

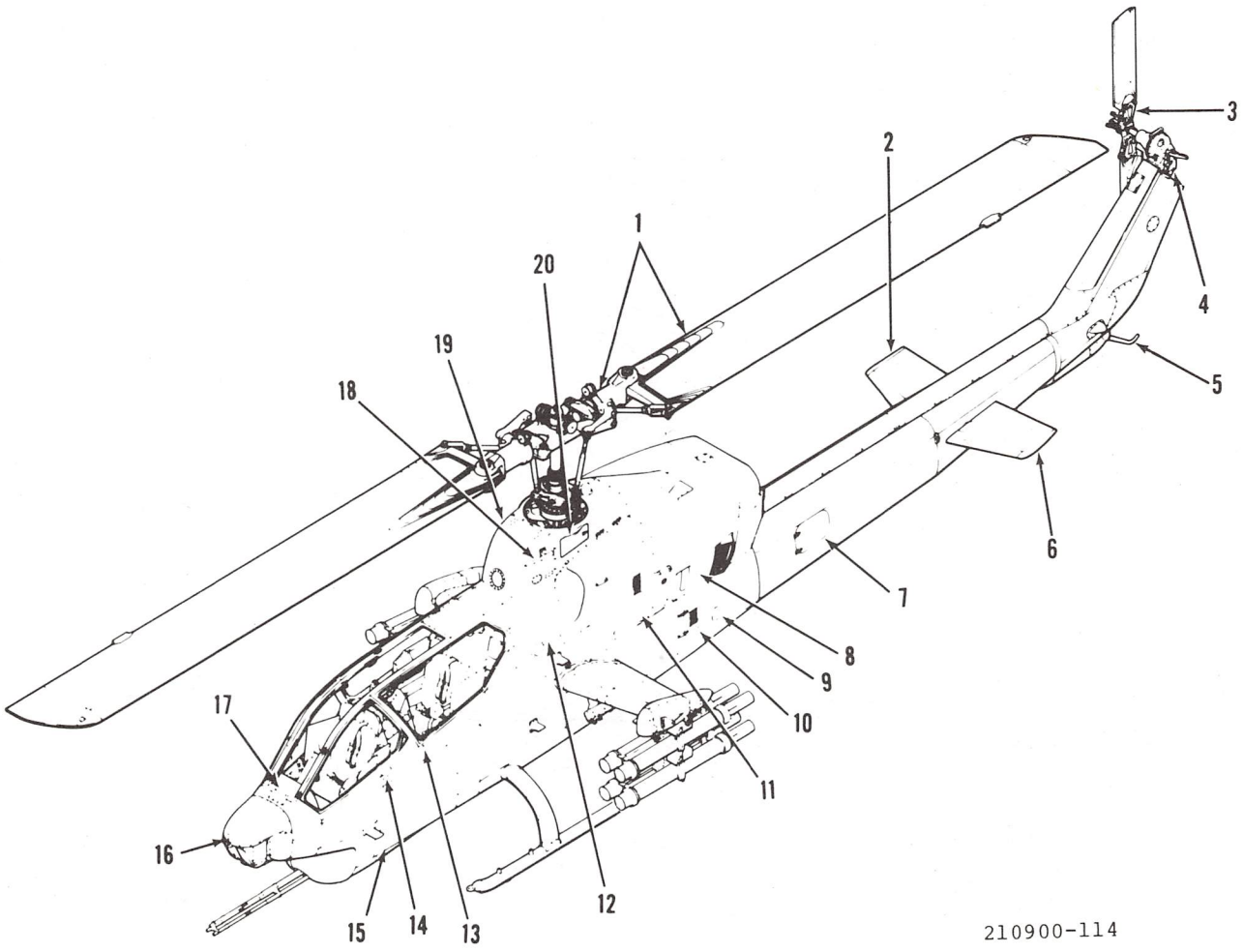
HELICOPTER ARRANGEMENT.

Refer to figure 1-1 for general arrangement.

Refer to figure 1-2 for principal dimensions.

Refer to figure 1-3 for pilot station diagram.

Refer to figure 1-4 for copilot/gunner station diagram.



1. HUB AND BLADE ASSEMBLY
2. RIGHT SYNCHRONIZED ELEVATOR
3. TAIL ROTOR HUB AND BLADE
4. 90 DEGREE GEARBOX
5. TAIL SKID
6. LEFT SYNCHRONIZED ELEVATOR
7. AFT ELECTRONICS COMPARTMENT DOOR
8. ENGINE COMPARTMENT (RH NOT SHOWN)
9. EXTERNAL POWER RECEPTACLE DOOR
10. ENGINE FIRE EXTINGUISHER ACCESS DOOR
11. TRANSMISSION COMPARTMENT (RH NOT SHOWN)
12. HYDRAULIC COMPARTMENT DOOR (RH NOT SHOWN)
13. FREE AIR TEMPERATURE GAGE
14. COPILOT/GUNNER DOOR SWITCH
15. AMMUNITION COMPARTMENT DOOR (RH NOT SHOWN)
16. TELESCOPIC SIGHT UNIT
17. RAIN REMOVAL DUCT
18. PITOT TUBE
19. PYLON ACCESS FAIRING
20. PYLON ACCESS DOOR (RH NOT SHOWN)

Figure 1-1. General Arrangement

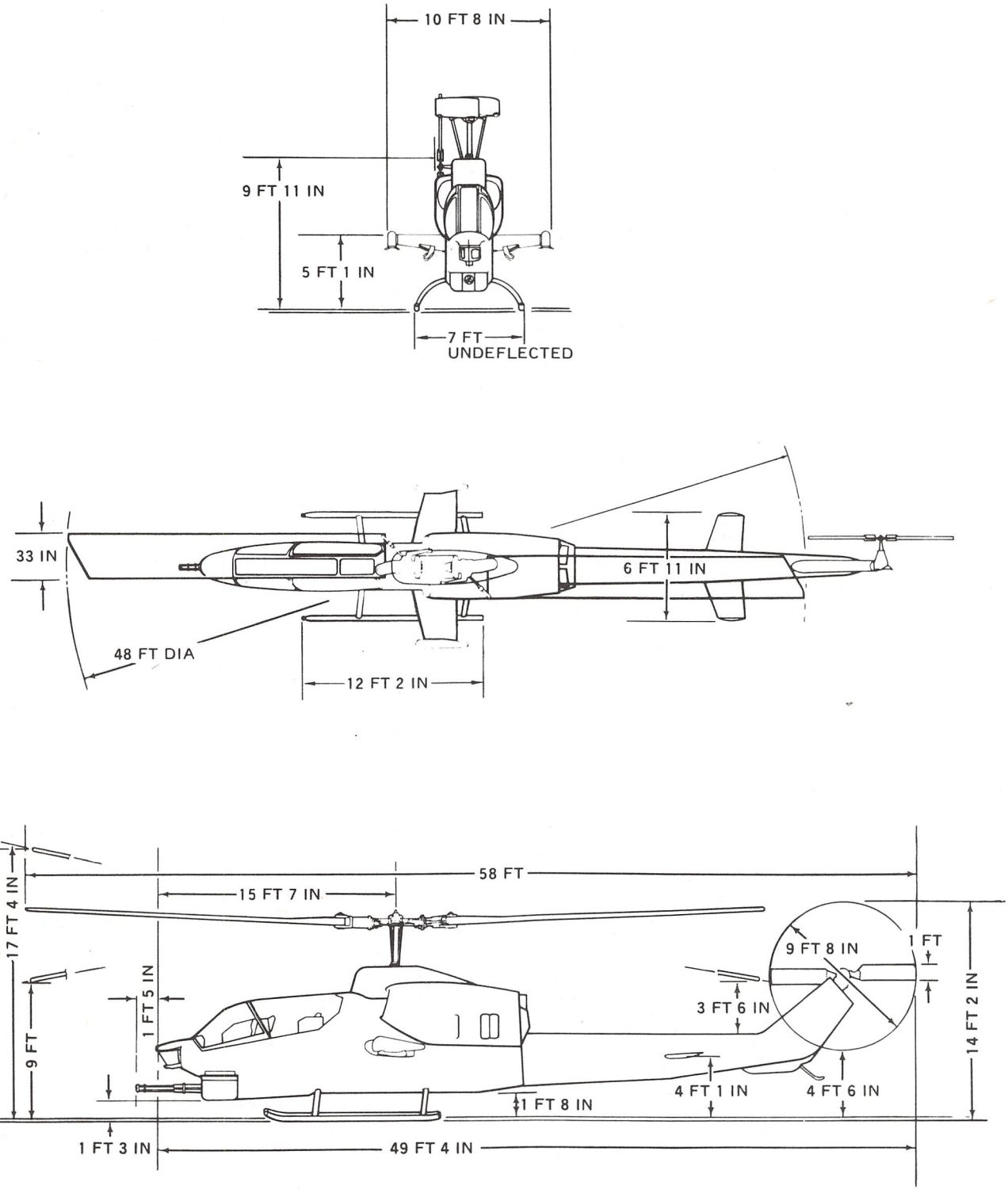
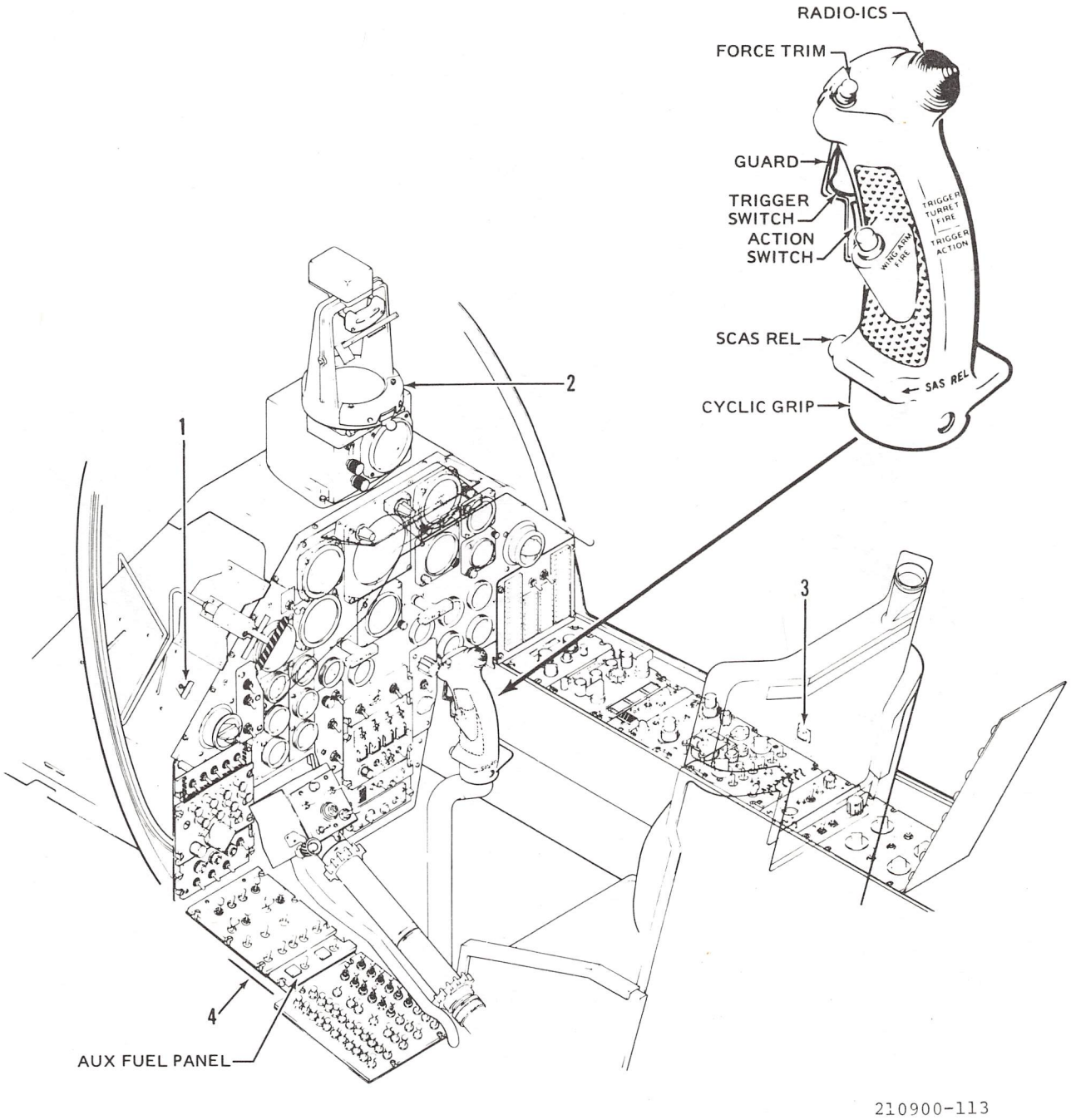


Figure 1-2. Principal Dimensions



1. LEFT DEFROST (RH NOT SHOWN)
2. PILOT FIXED SIGHT
3. CANOPY DOOR SWITCH
4. SMOKE GRENADE CONTROL PANEL (NOT SHOWN)

Figure 1-3. Pilot Station

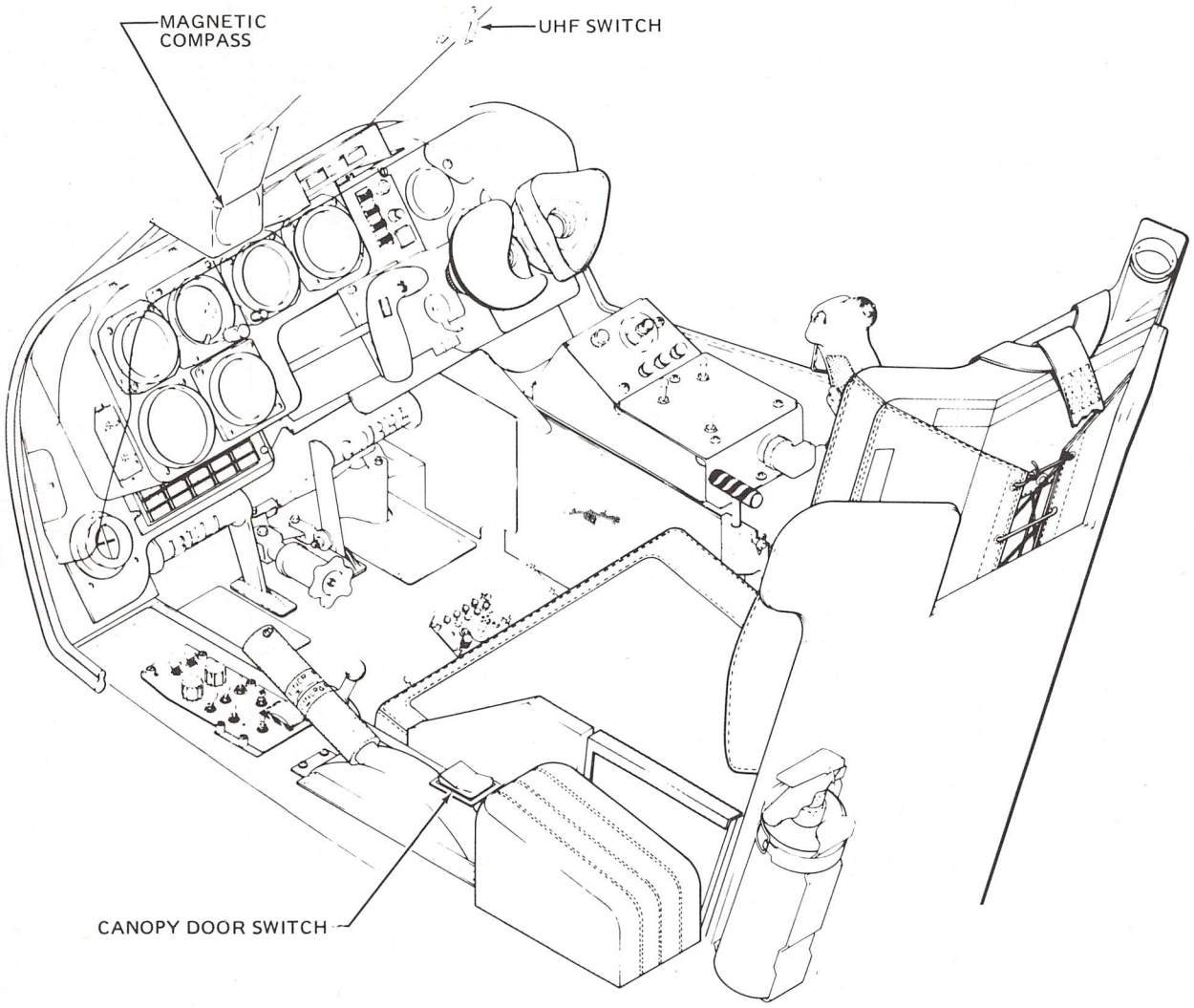


Figure 1-4. Copilot/Gunner Station

PART 2 — SYSTEMS

POWER PLANT.

The power plant consists of two independent engines driving a combining gearbox. The combining gearbox contains an overrunning clutch and a torque meter for each engine. Each engine has a three stage axial, single stage centrifugal compressor driven by a single stage turbine. Another single stage turbine counterrotating with the first, drives into the combining gearbox. Fuel is sprayed in the annular combustion chamber by fourteen individually removable fuel nozzles mounted around the gas generator case. A high tension ignition unit (figure 1-7), and two spark igniter plugs are used to start combustion. A hydro-pneumatic fuel control schedules fuel flow to provide the power required to maintain the desired output shaft speed. Automatic load sharing is provided. In addition, a manually operated fuel system is provided within the fuel control system. Refer to figure 1-9.

Combining Gearbox.

The combining (reduction) gearbox located on the aft portion of the engines (figure 1-6) has two identical reduction gear trains which transmit torque from each engine to a common output shaft. Each gear train has three stages. A uni-directional drive clutch is incorporated with the third stage shaft allowing torque to be transmitted in one direction only. A gearbox output section is composed of the common output-shaft and both third stage shafts. The lubrication for the gearbox output section is independent of the engines and self-contained with the combining gearbox. The first two stages and accessory drives obtain lubrication from their respective engines. A power turbine governor tachometer-generator, oil cooler blower pad and torquemeter oil pressure transmitter are fitted for each engine on separate mounts on the combining gearbox and are driven by their respective engines.

NEW

Engine Air Particle Separator System.

The particle separator consists of a series of inter-connected ducts and valves that provide each engine with air free of foreign particles (figure 1-8). During normal operating conditions, air approaching the engine inlet is partially bypassed through an ejector. Air flow is controlled by a two position door located downstream of the engine inlet duct. With the door in the open position, action of the air turning into the engine inlet will remove foreign particles.

Particle Separator Switch.

NEW

The particle separator switches are three-position switches labeled ON, AUTO, and OFF (figure 1-5). The ON position opens the door and the PART SEP OFF caution light will extinguish when the door is completely open. The OFF position closes the door to route all air into the engine and the PART SEP OFF caution light will illuminate when closed. The AUTO position ties the door actuation in with the engine low rpm indication system. In the AUTO position the door will be open unless the gas producer rpm drops to 52.5 ± 2%. When either engine drops to 52.5 ± 2% gas producer rpm, the RPM caution light will illuminate, the particle separator door will close, and the PART SEP OFF caution light will illuminate.

NEW NEW

Actuation of a FIRE PULL handle will close the respective door, regardless of switch position. Power is supplied by 28 vdc essential bus and is protected by ENG AIR BYP VALVE circuit breaker.

NOTE

The AUTO position shall be used at all times when visible moisture is evident.

PARTICLE SEPARATOR CAUTION LIGHT.

The particle separator caution lights, one for each engine duct, are located on the pilot caution panel and labeled PART SEP OFF. Any position other than full open will cause the light to illuminate.

Engine Fuel System.

The engine fuel system consists of separate identical engine fuel control systems and fuel pumps plus a common torque control unit (figure 1-9), Fuel from the boost pump enters the engine fuel pump housing and passes through a filter (with

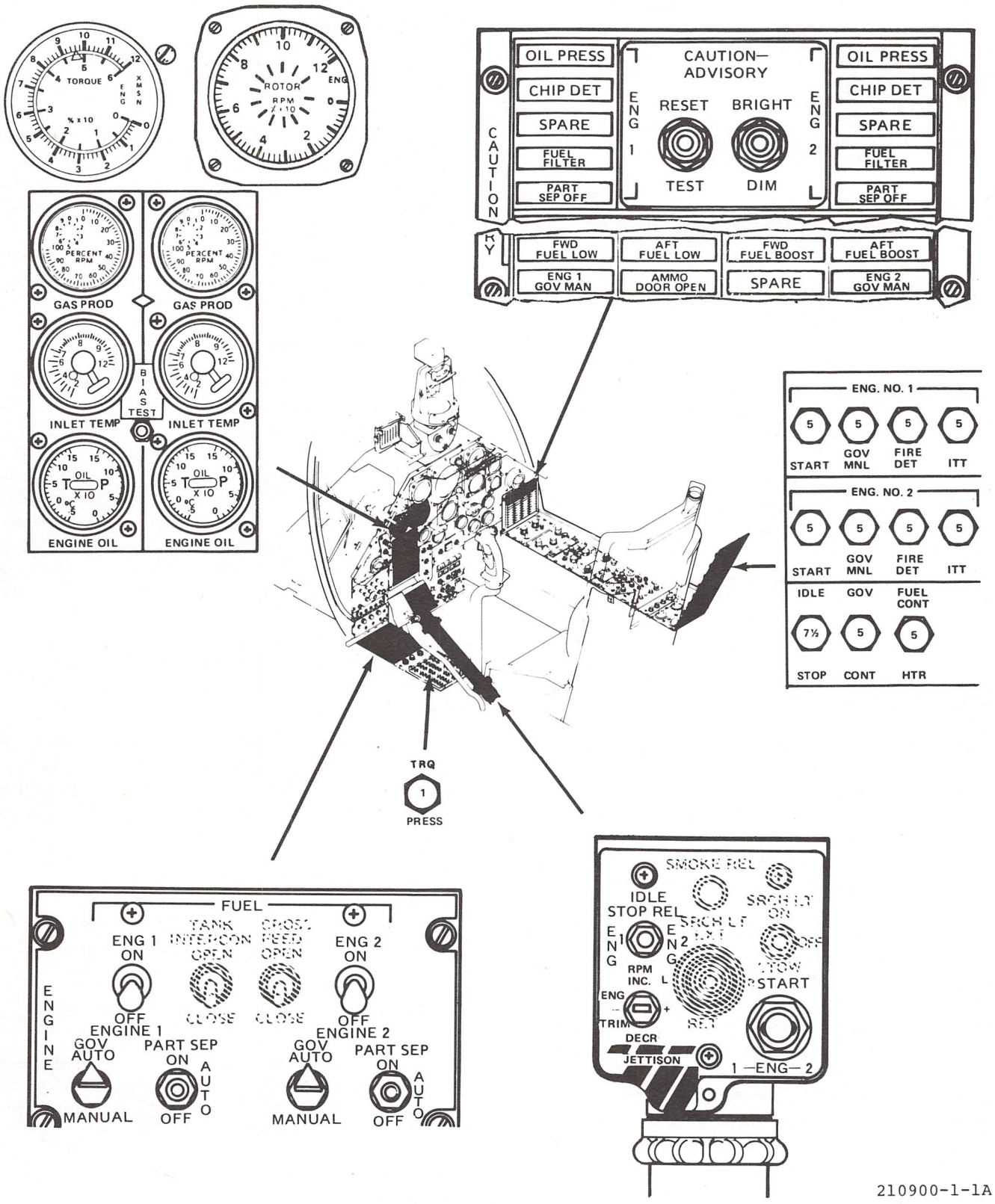


Figure 1-5. Engine Controls and Indicators (Sheet 1 of 2)

NOMENCLATURE	FUNCTION
GAS PROD indicator	Displays percent Ng rpm
INLET TEMP indicator	Displays degrees Celsius inlet turbine temperature
ENGINE OIL indicator	Displays oil temperature in degrees Celsius/ oil pressure in psi.
TORQUE indicator	Displays engine and transmission torque on respective needle.
TACHOMETER indicator	Displays percent Nf/Nr rpm on respective needle.
Caution lights	Illuminate to show fault condition (yellow)
Advisory lights	Illuminate to show advisory condition (green)
Circuit breakers	Protect engine electrical circuits
Throttle	Manual fuel control of each engine
START switch	Energizes start cycle to respective engine
IDLE STOP REL switch	Moves idle stop to allow full throttle travel
RPM switch	INC/DECR — Adjust Nf rpm
ENG TRIM +/–	Match engines
ENG FUEL switch	Supplies fuel to respective engine fuel control
GOV switch	Selects AUTO or MANUAL mode of fuel control operation to respective engine
PART SEP switch	OFF — Particle separator door closed AUTO — Particle separator door position open or closed depending on engine rpm ON — Particle separator door open.

210900-1-2A

Figure 1-5. Engine Controls and Indicators (Sheet 2 of 2)

bypass capability), then to the fuel pump. From the fuel pump, fuel passes through a transfer valve to either automatic or manual fuel control units as selected.

AUTOMATIC FUEL CONTROL UNIT (AFCU).

The automatic fuel control system of each engine consists of an automatic fuel control unit (incorporating a gas producer turbine governor) and a power turbine governor (common to both engines automatic fuel control systems) (figure 1-9). The automatic fuel control unit integrates signals from the power turbine governor and from its integral gas producer turbine governor, and allows a fuel flow up to the maximum demand, provided that the sensed limits are not exceeded.

POWER TURBINE GOVERNOR. The power turbine governors are mounted on the combining gearbox and are driven to a speed proportional to that of the power turbine (figure 1-9). It supplies a signal to the automatic fuel control unit to change gas producer turbine speed whenever it detects a power turbine speed change. When the engine is operating in automatic mode, the automatic fuel control unit may be set to maximum position without incurring a power turbine overspeed. The governing speed is adjusted by the RPM switch (figure 1-5).

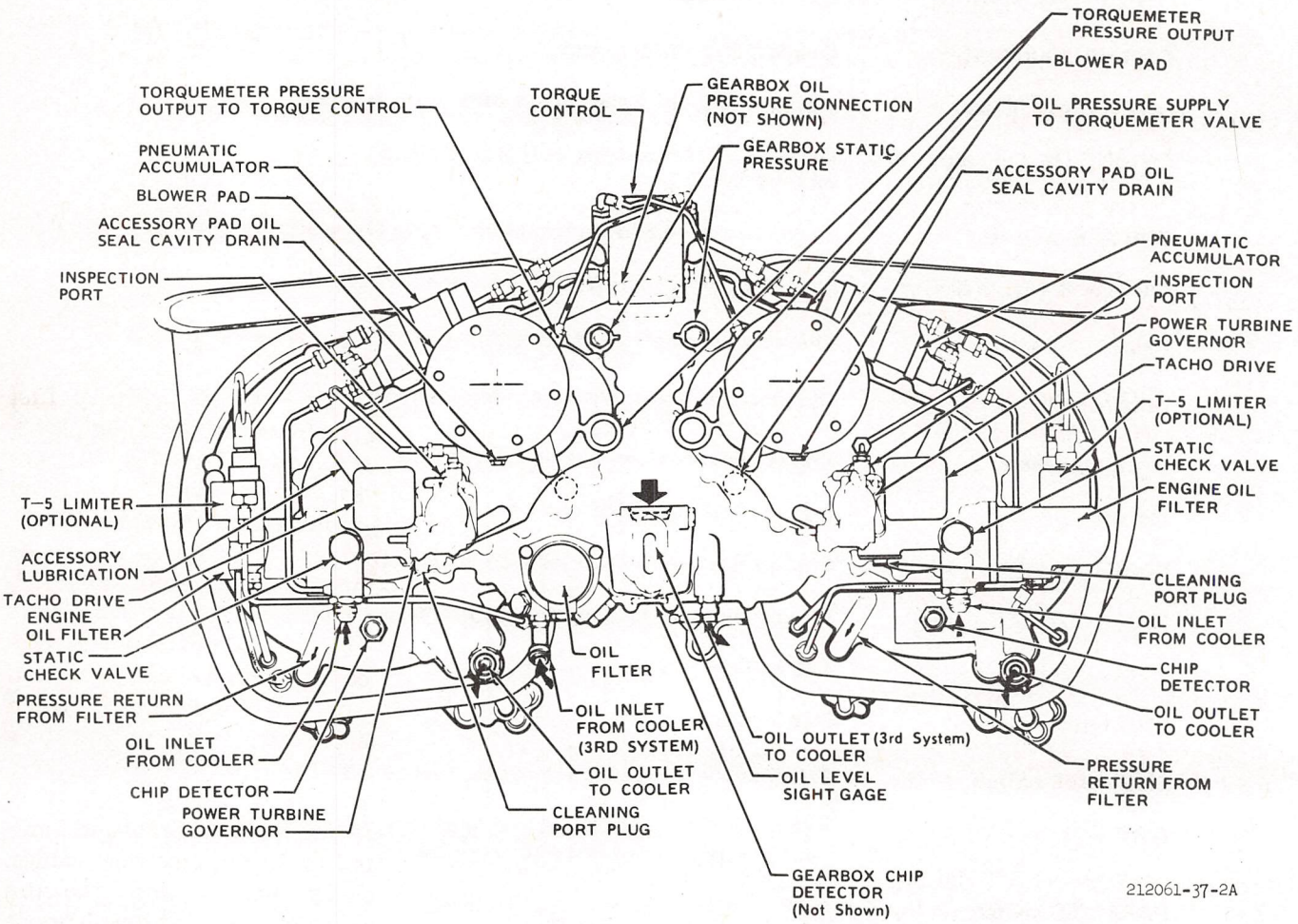


Figure 1-6. Aft Sections of Engines Combining Gearbox and Accessories

MANUAL FUEL CONTROL.

In manual operation, the solenoid is energized causing the transfer valve to direct fuel flow to the manual fuel control. The pilot controls fuel flow by throttle movement.

The manual control does not incorporate devices to automatically limit the major engine parameters, namely, Ng and Nf, torque and ITT. Consequently in the manual mode of operation the operator must monitor all engine instruments, make changes in power settings gradually and exercise the additional skill required to ensure that operating limits are not exceeded.

NEW

Engine Controls.

THROTTLES.

The throttles are located on each collective stick. They consist of two grip-type throttles which are used for manually controlling fuel flow to the engines. The throttle grips are rotated to the left to increase and to the right to decrease engine power. Friction is induced into the pilot throttle grips by rotating the rings at the upper and lower ends of the throttle grips (figure 1-5). Index markers are provided to show pilot the throttles are at equal setting. Idle stops prevent inadvertent engine shutdowns. When the ENGINE 1 GOV and ENGINE 2 GOV switches are in AUTO, the fuel flow is automatic. In MANUAL, fuel flow is controlled by the pilot.

Engine Chip Detectors.

The pilot and copilot/gunner caution panels each have chip detector caution lights for each engine. The lights are connected to magnetic plugs, which

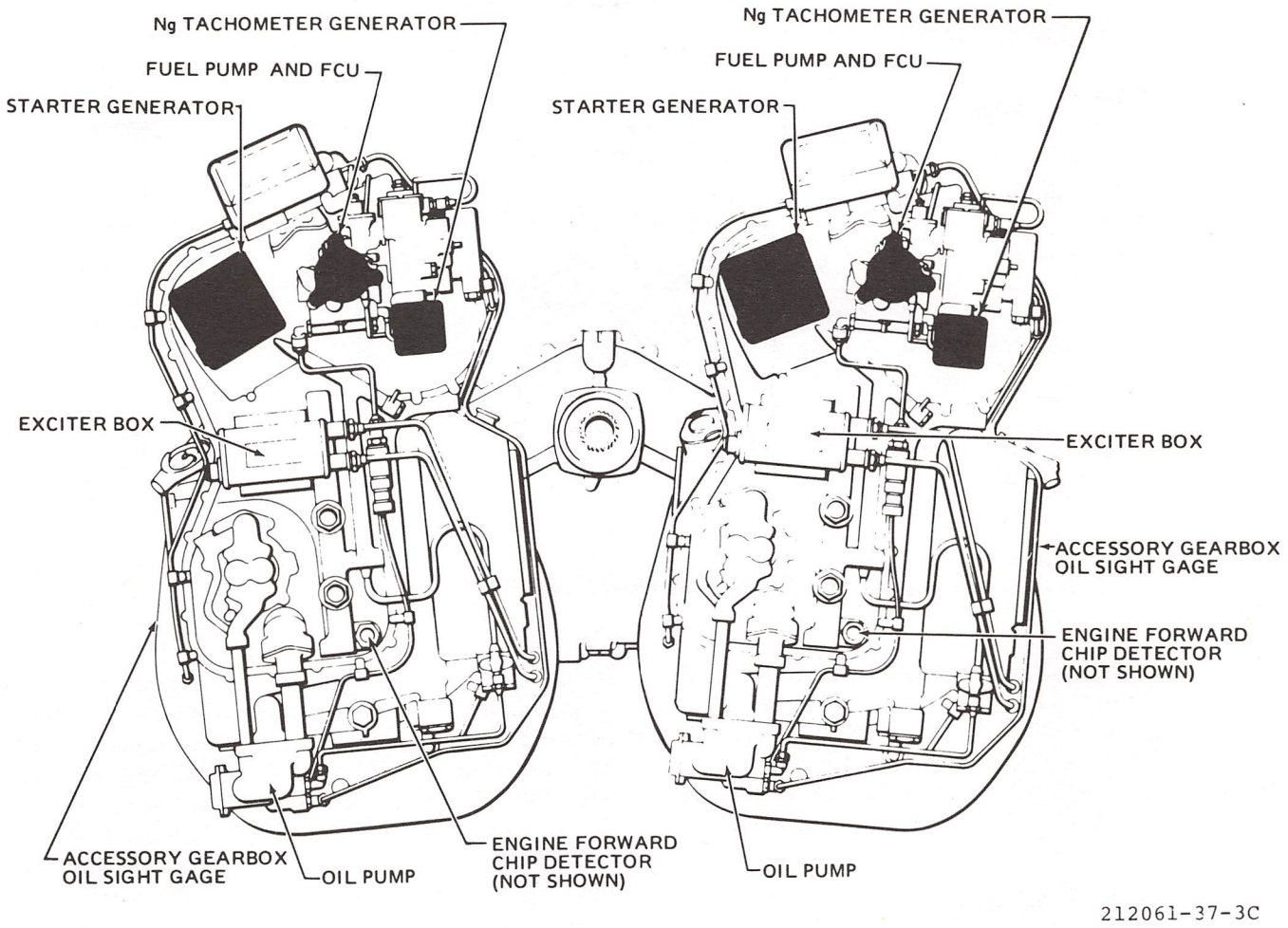


Figure 1-7. Accessory Gearbox Sections and Components

are installed in the engines. When a magnetic plug attracts enough metal particles to complete the circuit, the ENGINE (1 or 2) CHIP DETR caution light will illuminate to indicate the affected engine. Power is supplied by the 28 vdc essential bus and protected by the CAUTION LIGHTS circuit breaker.

Power Plant Oil Systems.

There are three independent oil systems; one for each engine and the third for the combining gearbox output section (figure 1-10). The operation of the oil system is completely automatic and self-regulating. Each engine oil system is used in the torquemeter system to supply an indication of engine torque. Each system has its own integral tank, oil level sight glass, tank filling aperture, filter and drain plugs. The oil level sight glass and filling aperture for each engine are located on the accessory gearbox. The oil level sight glass, filling aperture, and drain plug of the combining gearbox section oil system are located on the combining gearbox.

POWER PLANT OIL COOLING.

Oil cooling is accomplished by a separate oil cooler for each engine and combining gearbox oil system (figure 1-10). Each system has bypass valves for bypassing the oil coolers. The engine oil coolers are mounted with the transmission / combining gearbox oil coolers aft of the engine. The

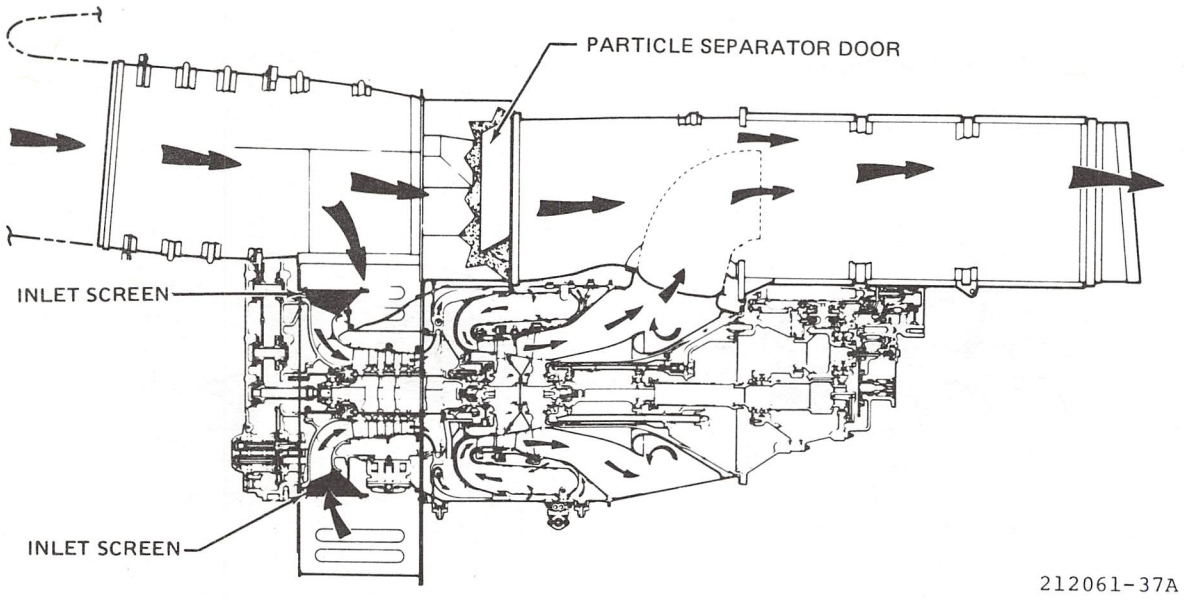


Figure 1-8. Engine Air Flow T400-WV402 Engine

combining gearbox oil cooler and transmission oil cooler are combined in one unit, but are separate coolers. Air for cooling the oil is provided by two fans, mounted on and driven by the combining gearbox. The fans automatically run when the engine is running, and no control is provided.

Engine Idle Stop Release Switch.

The engine IDLE STOP REL switch (figure 1-5) is a three position momentary-on type switch. The pilot IDLE STOP REL switch is on the collective switch box. The copilot/gunner IDLE STOP RLSE switch is located on the miscellaneous control panel. The switch energizes electrical solenoids with retractable plungers. The solenoids are mounted so that the plungers act as stops in the throttle linkages. The stops prevent the pilot or copilot/gunner from accidentally increasing or decreasing throttles through idle. To open or close throttles, the switch must be placed in ENG 1 or ENG 2 position respectively. A five-second delay is built into the switch to allow time to open or close throttles. Power is supplied by 28 vdc essential bus and protected by the IDLE STOP circuit breaker.

Engine RPM Switch.

The pilot RPM switch is mounted on the collective switch box (figure 1-5). The copilot/gunner switch is on the miscellaneous control panel. The pilot switch is a five-position momentary-on type. The forward (INC) position increases engine rpm. The aft (DECR) position decreases engine rpm. The INC/DECR positions control the governors on both engines simultaneously. Regulated engine rpm may be adjusted in flight, through the operating range of 97% to 101.5 + 0.5% by movement of the switch. The +/- positions trim No. 2 engine torque to provide engine matching. The copilot/gunner does not have trim capability. Power is provided by the 28 vdc essential bus and protected by the GOV CONT circuit breaker.

Droop Compensator.

Droop is defined as the speed change in engine rpm (Nf) as power is increased from a no load condition. It is an inherent characteristic designed into the governor system. Without this characteristic, instability would develop as engine output is increased, resulting in Ng speed overshooting or hunting the value necessary to satisfy the new power condition. Design droop of the engine governor system is as much as 4.5% to 5.5% (300 to 400 rpm) (flat pitch to full power). If Nf power were allowed to droop other than momentarily, the reduction in rotor speed would become critical; therefore, a droop compensator is installed on the governor control to raise Nf speed as power is

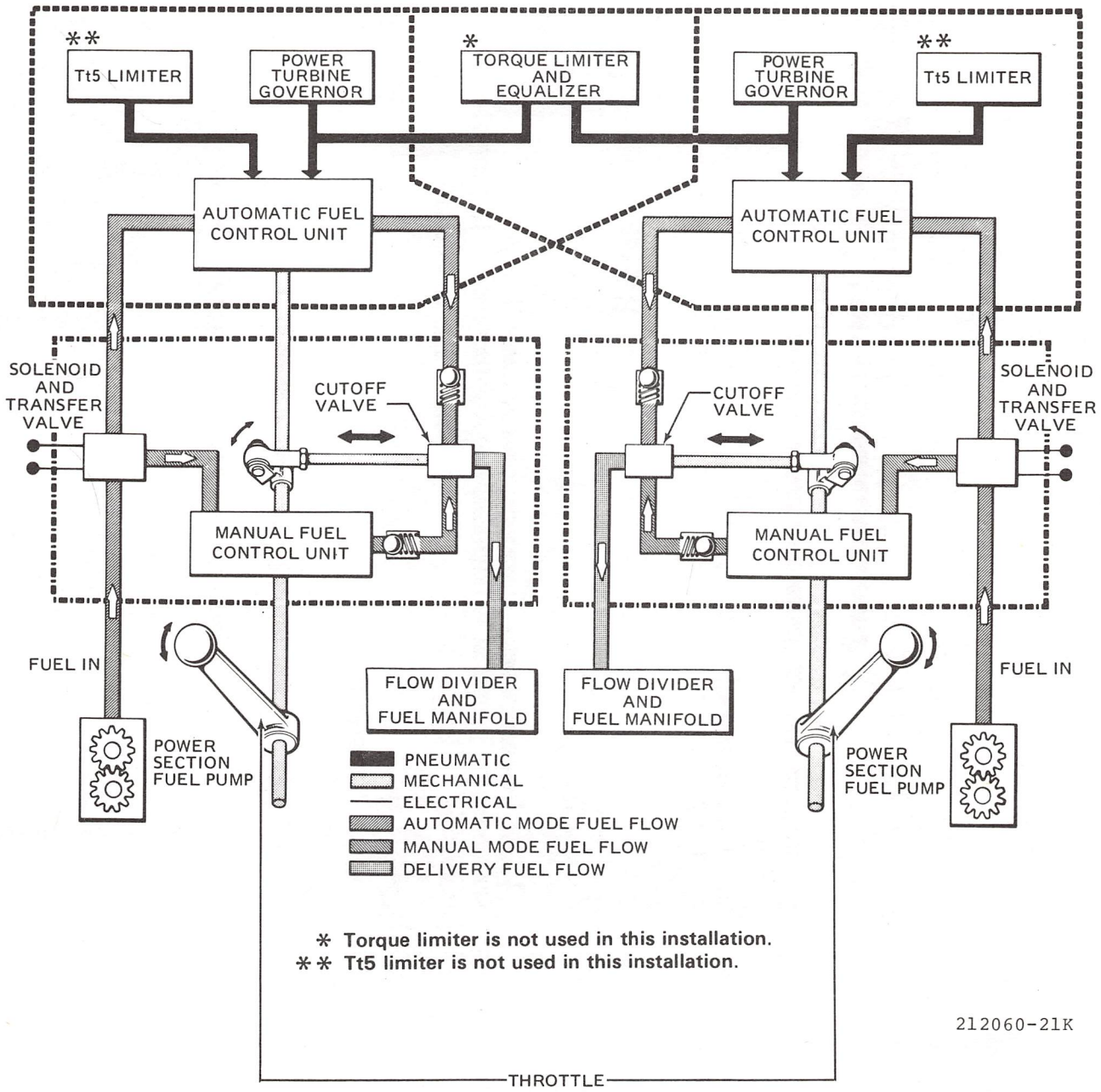
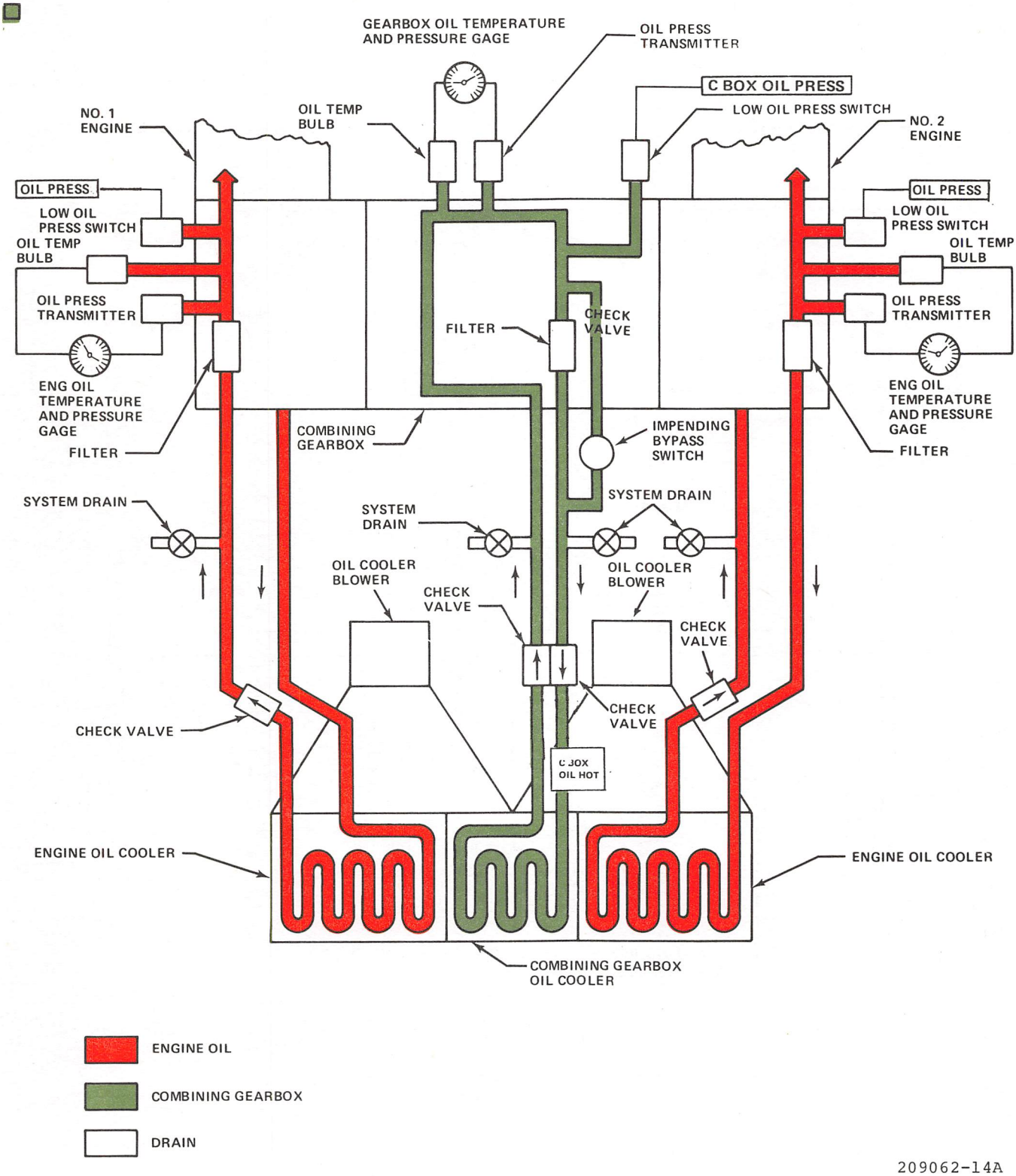


Figure 1-9. Engine Fuel Control System — Schematic



NEW

Figure 1-10. Engine Oil System

increased to the rpm value selected by the pilot. The compensator is a direct mechnical linkage between the collective control lever and the speed selector lever on the Nf governor. Properly rigged, the droop compensator will hold Nf rpm to plus or minus 1% rpm from flat pitch climb out power.

A shear pin is incorporated in the droop compensator linkage to permit collective control movement in the event of a bind occurring in the droop compensator linkage. When the pin is sheared, the droop compensator is inoperative and care must be taken to maneuver within power adjustment capabilities of the governor.

Governor Switch.

The ENGINE 1 GOV and ENGINE 2 GOV (pilot), ENG 1 GOV and ENG 2 GOV (copilot/gunner) switches are two-position toggle switches located on the pilot engine control panel (figure 1-5) and the copilot/gunner miscellaneous control panel. The AUTO position provides for automatic fuel metering to the engines. The MANUAL (pilot), MNL (copilot/gunner), position provides the pilot, or copilot/gunner, with manual control of fuel flow and illuminates the ENG 1 GOV MAN or ENG 2 GOV MAN ADVISORY light. Power is supplied by the 28 vdc essential bus and protected by the ENG NO.1 GOV MNL amd ENG NO. 2 GOV MNL circuit breakers.

Start Switch.

A three position START switch (push-down-to-unlock type) is mounted on the pilot collective stick switch box and is marked START/ENG 1 and 2. The switch actuates the starter and ignition circuit when placed in the ENG 1, or ENG 2 position. However, the engine ignition circuit is not energized unless the FUEL switch is ON.

The START switch is magnetically held in the ENG 1 or ENG 2 position and shall be manually returned to the center position. The START switch is powered by the 28 vdc bus and is protected by ENG NO 1 START and ENG NO 2 START circuit breakers.

Fuel Control Line Heater.

The fuel control sense line heaters prevent accumulation of ice in the engine governing system by maintaining temperature of at least 40°F. The fuel control heaters are energized from the 28 vdc essential bus, through circuit breakers marked FUEL CONT HTR (figure 1-5). The ENG 1 and ENG 2 FUEL switches control the engine 1 and engine 2 heaters respectively. NEW

Starter-Generator.

Two starter-generators are provided, one for each engine. The starter turns the gas producer turbine for starting. NEW

Should an unsatisfactory start occur, observe starter limitations (Section 1, Part 4). The starters are operated independently by the START switch. Power is supplied by the 24 vdc battery or from an external 28 vdc power source plugged into the external power receptacle. The starter-generators are mounted on the engine accessory gearboxes.

Engine Instruments and Indicators.

Pilot engine instruments, caution panel, and indicators are located on the instrument panel (figure 1-5). The copilot/gunner instruments, caution panel, and indicators are located on the instrument panel (figure 1-4).

ENGINES AND TRANSMISSION TORQUEMETER.

A triple torquemeter indicating torque on engines 1, 2, and transmission is located in the pilot and copilot/gunner instrument panels (figures 1-4, 1-5). The torquemeters indicate percentage of torque imposed on the engines output shafts. Each torquemeter displays the torque output of each engine on the inner dial and the torque to the transmission (combined torque of both engines) on the outer dial. The torque of engine 1 is indicated by pointer 1, the torque of engine 2 is indicated by pointer 2, and the sum of these torques is indicated by the cursor on the outer dial. The torquemeter system receives power from the 26 vac essential bus and is protected by the TRQ PRESS circuit breaker.

INTER-TURBINE TEMPERATURE INDICATORS.

Two inter-turbine temperature indicators, marked INLET TEMP, are located on the pilot, and two on the copilot/gunner, instrument panels (figures 1-4, 1-5). The indicators receive temperature

indications from each engine. Each system consists of twin leads, two bus-bars and thermocouple probes connected in parallel. Power is supplied by the 28 vdc essential bus and protected by the ENG 1 ITT and ENG 2 ITT circuit breakers. The high temperature warning light on the face of the gage will illuminate any time 837°C is exceeded. A BIAS TEST switch is located on the pilot instrument panel (figure 1-5). Placing the switch left or right deactivates the respective engine bias and will cause inlet temperature to show a higher indication.

ENGINE AND ROTOR TACHOMETER.

The triple tachometer is located on the pilot and copilot/gunner instrument panels (figures 1-4, 1-5). The indicators indicate rpm for both engines power turbines and the main rotor. The two long pointers marked 1 and 2 represent engines 1 and 2. NEW The rotor RPM indicator is marked R. The outer scale is for engines percent rpm and the inner scale is for rotor percent rpm. Power for each indicator is provided by 28 vdc essential bus and protected by the TRIPLE TACH IND circuit breaker. Normal operation is indicated when all three points are in synchronization.

GAS PRODUCER TURBINE TACHOMETER.

Two gas producer turbine tachometer indicators, marked GAS PROD, are located on the pilot instrument panel and two, marked GAS PRODUCER, on the copilot/gunner instrument panel (figures 1-4, 1-5). The indicators are powered by tachometer generators geared to the engine gas producer turbine shafts. The gas producer turbine tachometer operates independently of the electrical system. The indicator readings are in PERCENT RPM.

OIL PRESSURE AND TEMPERATURE INDICATORS.

Two engine oil pressure and temperature indicators are located on the pilot instrument panel (figure 1-5). There is a dual instrument for each engine. The oil pressure indicators receive psi indications from pressure transmitters on the engines. The temperature indicators receive Celsius indications from electrical resistance type thermocouples located on the engines. The pressure indicators are powered by 26 vac and protected by the ENG OIL PRESS circuit breaker. The temperature indicators are powered by the 28 vdc essential bus and protected by the ENG OIL TEMP IND circuit breaker.

LOW OIL PRESSURE CAUTION LIGHT. The pilot and copilot/gunner caution panels each have ENG 1 and ENG 2 OIL PRESS CAUTION lights for each engine. The caution lights are activated by low pressure switches which make contact when oil pressure drops below safe limits.

ROTOR SYSTEM.

Main Rotor.

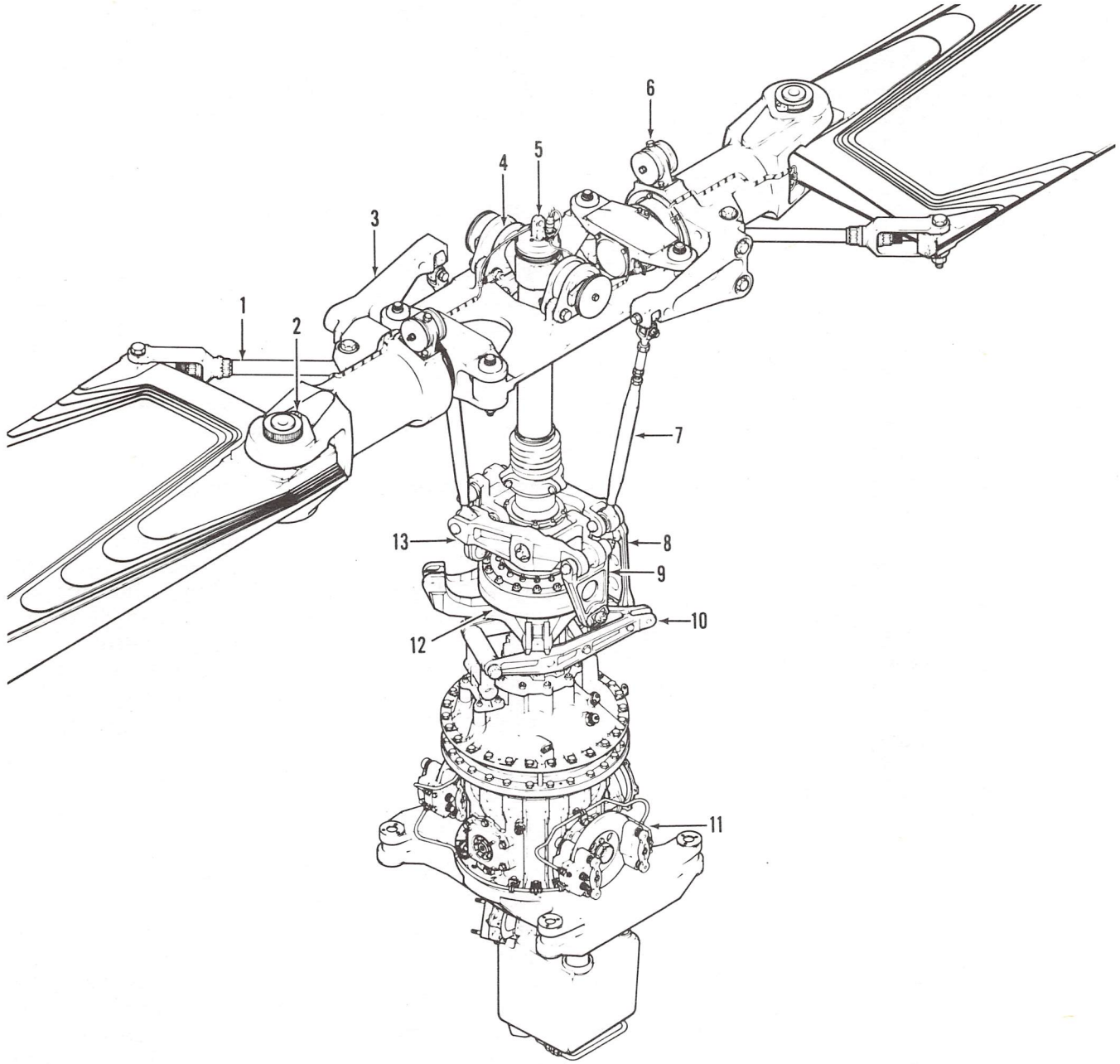
The main rotor hub and blade assembly is a two-bladed, semi-rigid seesaw type with preconing and underslinging to optimize dynamic stability (figure 1-11).

The main rotor hub and blade assembly consists of a blade attached to each grip and spindle assembly. The grip and spindle assembly is attached to a common yoke assembly.

The grip and spindle assembly is the pitch change element and consists of oil lubricated roller bearings, elastomeric oil seals, tension torsion straps, strap pins and fittings, spindle, grip drag brace, and pitch horn.

The yoke assembly consists of a flex beam yoke, with a trunnion and elastomeric bearings mounted in the center section to form the flapping axis 90 degrees to the pitch change axis.

The main rotor control system consists of a swashplate mounted on a spherical surface for cyclic input, a sleeve for collective input and scissors levers mounted on the sleeve assembly box for mixing these motions. Pitch links are attached between each scissor lever and rotor pitch horn for collective and cyclic control.



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1. DRAG BRACE
2. BLADE PIN LOCK
3. PITCH HORN
4. ROTOR HUB TRUNNION
5. MAIN ROTOR RETAINING NUT
6. GRIP RESERVOIR
7. PITCH CHANGE TUBE
8. ANTIDRIVE LINK
9. DRIVE LINK
10. COLLECTIVE LEVER
11. LEFT ROTOR BRAKE
12. SWASHPLATE
13. SCISSORS ASSEMBLY

Figure 1-11. Main Rotor System

RPM Caution System.

The RPM caution system provides indication of high rotor rpm, low rotor rpm and low gas producer turbine rpm. Main components are ROTOR RPM switch and RPM caution light (figure 1-14). Electrical power is provided by the 28 vdc essential bus and is protected by the RPM WRN lights circuit breaker.

RPM CAUTION.

The RPM caution lights, located on the center of pilot and copilot/gunner glareshields, illuminate when rotor rpm increases to 103±2%, rotor rpm decreases to 92±2% or either gas producer rpm decreases to 52.5 ± 2%. When either gas producer rpm decreases to 52.5 ± 2%, respective particle separator door closes and PART SEP OFF caution light illuminates.

ROTOR RPM SWITCH.

The ROTOR RPM switch, marked AUDIO and OFF, is located on the pilot POWER panel (figure 1-14). OFF position prevents audio function during engine starting when audio might be objectionable. Switch automatically positions to AUDIO when engine and rotor reach operating rpm. AUDIO position provides an audio signal in pilot and copilot/gunner headset when rotor rpm decreases to 92±2%.

Tail Rotor.

The tail rotor hub and blade assembly is a two-bladed, semi-rigid rotor with a skewed flapping axis with preconing and underslinging to optimize dynamic stability.

The tail rotor hub and blade assembly consists of a blade attached to grip plates by bolts. The grip plates are mounted on a common flex beam yoke by a spherical pitch change bearing. A split trunnion is mounted on the yoke center section by spherical flapping bearings.

The tail rotor control system consist of a walking beam and idlers for translating pedal input through the fixed control system to the control tube (FO-5). The control tube extends through the 90 degree gearbox and is attached to the crosshead. Pitch change links connect the crosshead and pitch horns for pitch changes resulting from pedal movement. An active counter balance system, activated by pitch change, offsets the blades restoring moment, resulting in the ability to fly boost-off if the requirement should occur.

TRANSMISSION SYSTEM.

The transmission is mounted forward of the engine and is coupled to the engine by a driveshaft. It transmits engine power to the rotors and accessories. The transmission system includes the main rotor transmission systems, tail rotor transmission system, accessory drive pads, speed sensors, and associated lubrication systems.

Main Rotor Transmission System.

The main rotor transmission system consists of the main transmission, mast assembly, and input driveshaft (figure 1-12). The main transmission accepts inputs from the engine and decreases speed to the main rotor mast, tail rotor, and transmission mounted accessories. The mast assembly transmits power from the transmission system to the main rotor. The driveshaft transmits power from the engine to the main transmission input quill.

TRANSMISSION OIL SYSTEM.

The transmission oil system is a wet sump type consisting of a pressure pump, oil cooler, automatic emergency oil cooler bypass system, pressure relief valve and bypass manifold, oil filter, jets, valves, and associated hardware (figure 1-13). These components are integral to the transmission except for the oil cooler and filter which are fuselage mounted. Transmission lubrication is accomplished by a self-contained pressure oil system. The oil pump is immersed in a wet sump at the lower end of the transmission.

TRANSMISSION OIL COOLER.

The transmission oil cooler is a self-contained system with independent thermostatic valves and bypass provisions as a part of the transmission oil cooling system. The system has an automatic emergency oil cooler bypass valve that routes the oil around the oil cooler or lines, if the cooler or lines are ruptured.

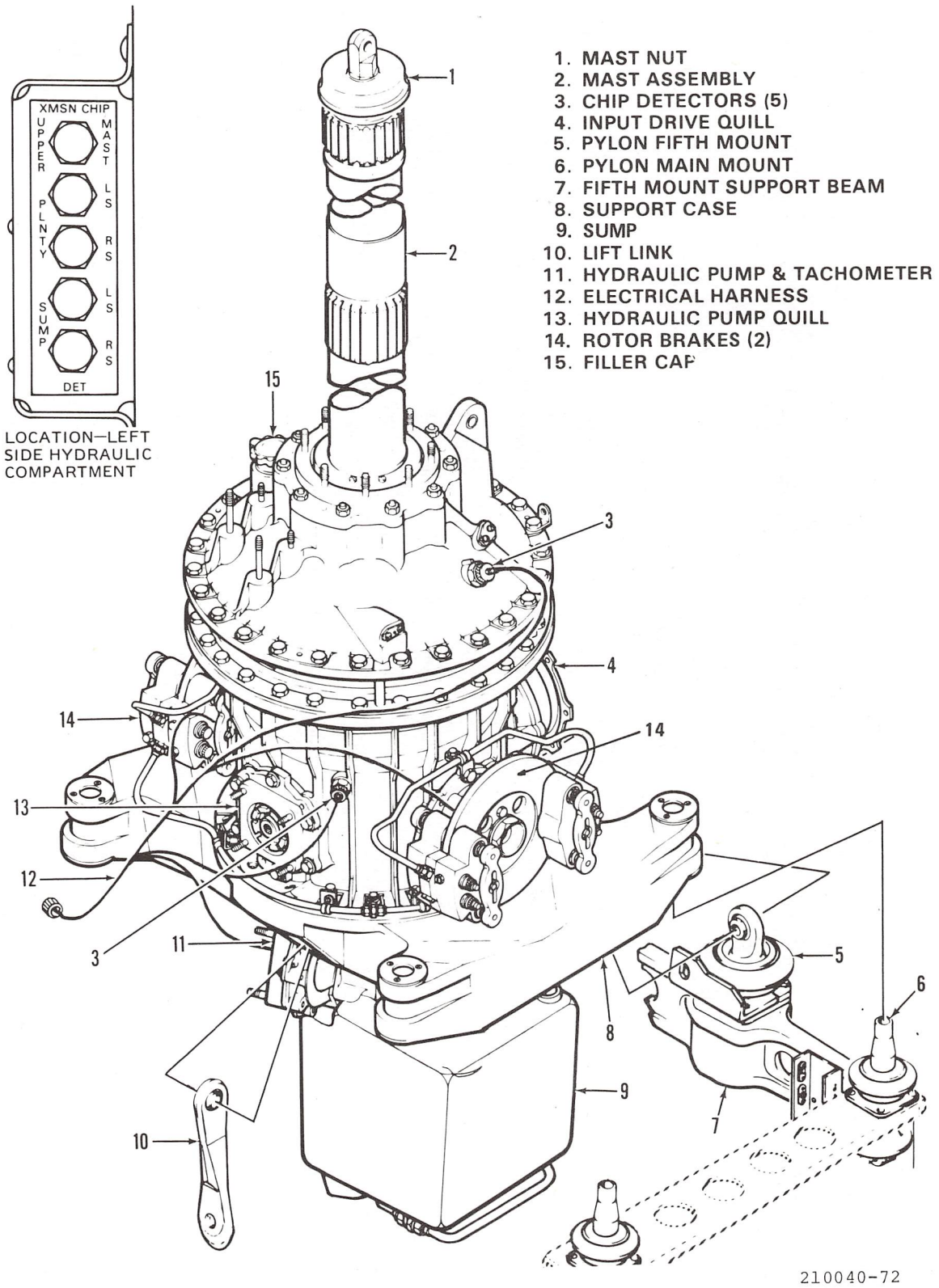


Figure 1-12. Main Transmission

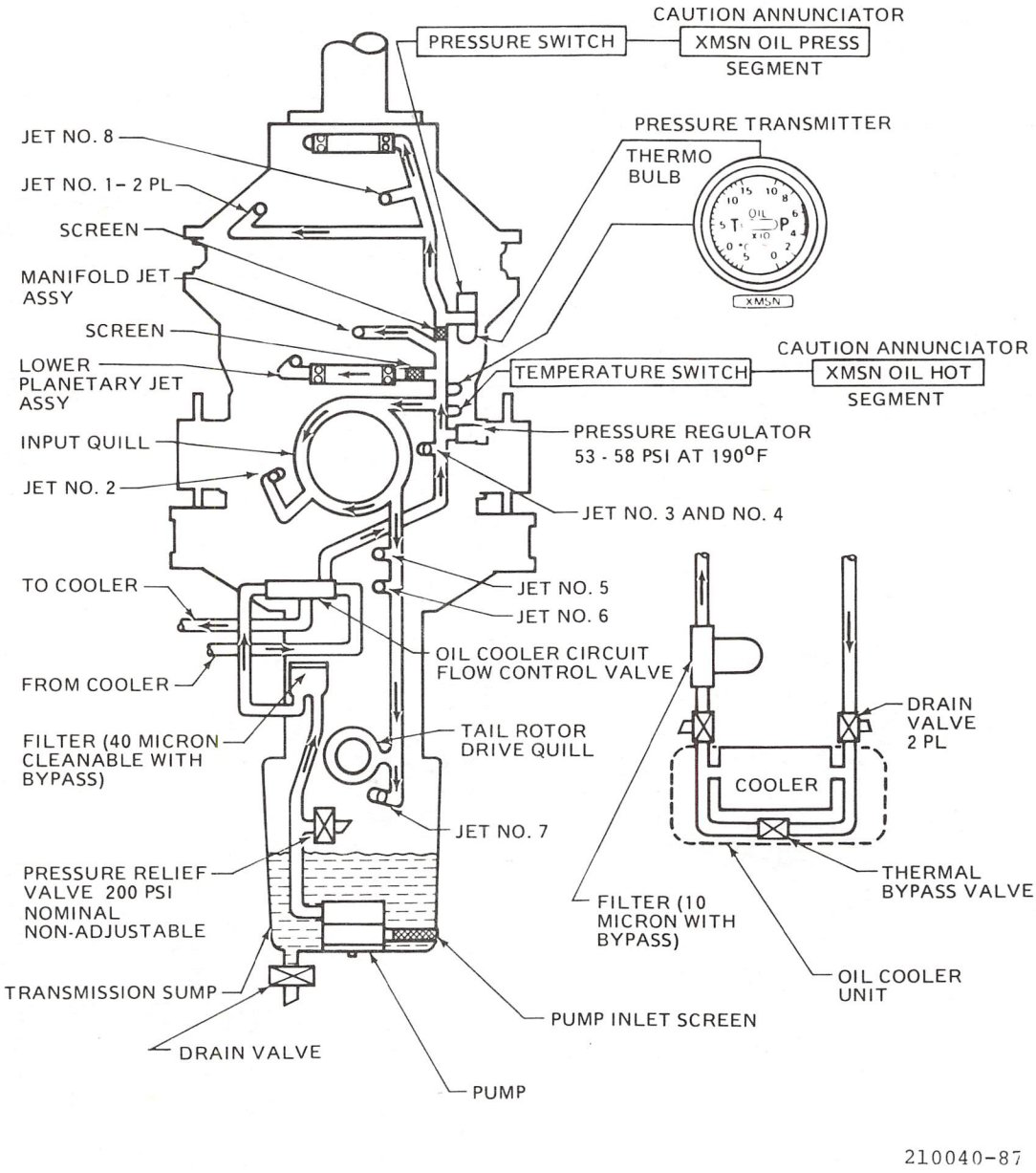
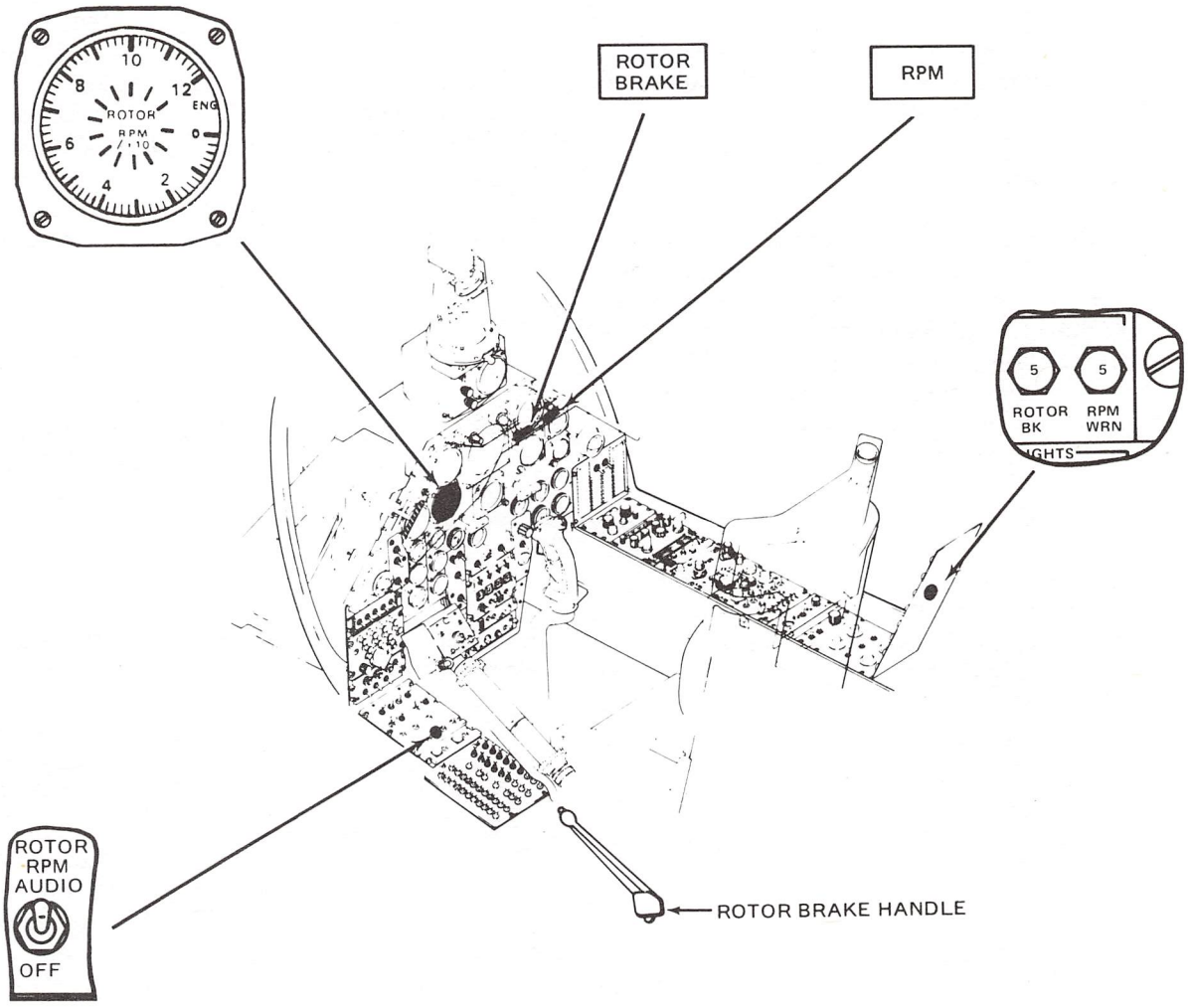


Figure 1-13. Transmission Oil System



NOMENCLATURE	FUNCTION
Tachometer indicator	Display rotor rpm in percent.
ROTOR BRAKE warning light	Illuminate to indicate rotor brake applied.
RPM caution light	Illuminate to indicate high or low rpm.
Circuit breakers	Provide circuit protection.
Rotor brake handle	Slow or hold rotor.
ROTOR RPM switch	Deactivate audio rpm warning.

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Figure 1-14. Rotor System Indicator

ACCESSORY DRIVE PADS.

The main rotor transmission system incorporates drive pads for hydraulic pumps, rotor brake, and rotor tachometer generator.

Transmission Indicators.

The transmission indicators consist of an oil pressure indicator, oil pressure caution light, oil temperature indicator, oil temperature caution light, chip detector caution light and an oil bypass caution light.. The combining gearbox indicators consist of oil temperature and pressure indicators, oil temperatue and pressure caution lights, and a chip detector caution light (figures 1-4, 1-5).

OIL PRESSURE TEMPERATURE INDICATOR.

The transmission oil temperature and oil pressure indicators are contained in the same case. It is located in the pilot instrument panel and is marked XMSN OIL T/P. The oil pressure indicator is powered by the 26 vac ESSENTIAL BUS, and protected by the XMSN OIL PRESS circuit breaker. An electrical thermobulb transmits the oil temperature to the indicator. The temperature indicator is powered by 28 vdc essential bus, and is protected by the XMSN OIL TEMP IND circuit breaker.

OIL PRESSURE CAUTION LIGHT.

A XMSN OIL PRESS caution light is located on the pilot and copilot/gunner caution panels. The lights are connected to a transmission mounted pressure switch. A drop in oil pressure below safe operating limits illuminates the caution lights.

OIL TEMPERATURE CAUTION LIGHTS.

A XMSN OIL HOT caution light is located on the pilot and copilot/gunner caution panels. The lights are connected to a transmission mounted thermoswitch. When the transmission oil temperature is above safe operating limits, the switch closes and the caution light illuminates.

TRANSMISSION CHIP DETECTOR CAUTION LIGHTS.

The illumination of the XMSN CHIP DETR caution light, on the pilot and copilot/gunner caution panels indicates the transmission mounted chip detectors have collected enough chip or foreign material to complete the circuit. The XMSN CHIP DET panel, located in the left hydraulic compartment has five transmission chip detector lights which isolate each of the chip detectors. The XMSN CHIP DET panel lights are UPPER MAST, PLNTY LS, PLNTY RS, SUMP LS, and SUMP RS. One or more of the five lights will be illuminated when the pilot and copilot/gunner XMSN CHIP DETR caution light is illuminated.

OIL BYPASS CAUTION LIGHT.

The XMSN OIL BYP caution light is illuminated when the transmission oil system bypass valve is in the bypass position. The transmission oil is then being routed around the oil cooler. The bypass valve closes automatically because of differential flow between the pump and cooler outlet.

Combining Gearbox Oil Temperature and Pressure Indicator.

The combining gearbox oil temperature and pressure indicator is a dual indicator, registering temperature in Celsius and pressure in psi (figure 1-36). The temperature portion receives indications from an electrical resistance bulb and the pressure portion receives its signal from the pressure transmitter. The temperature portion is powered by the 28 vdc essential bus and protected by the C BOX OIL TEMP IND circuit breaker. The pressure portion is powered by the 26 vac essential bus and protected by the C BOX OIL PRESS circuit breaker. If oil pressure in the gearbox drops below safe limit, the C BOX OIL PRESS caution light will illuminate. The caution light is powered by the 28 vdc essential bus and protected by the CAUTION LIGHTS circuit breaker.

COMBINING GEARBOX CHIP DETECTOR CAUTION LIGHT.

The illumination of the C BOX CHIP DETR caution light on the pilot and copilot/gunner caution panels indicates the combining gearbox chip detector has collected enough chips or foreign material to complete the circuit.

Tail Rotor Transmission System.

The tail rotor transmission system consists of shaft assemblies, hanger bearing assemblies, flexible couplings, and gearboxes. Four hanger

bearings are installed to support the shaft sections. Couplings are used at the main transmission output drive and at the forward side of the first hanger bearing to accommodate motion, and on the 42 degree gearbox output drive to accommodate fin deflection. Flexible disc couplings are installed at the remaining hanger bearings, the 42 degree gearbox, and the 90 degree gearbox to accommodate airframe deflections. A fan is mounted on the 42 degree gearbox output coupling to provide cooling for the gearbox.

42 DEGREE GEARBOX CAUTION LIGHTS.

The 42 degree gearbox caution light is located in the pilot caution panel. The caution light will illuminate 42° TEMP/PRESS when the oil temperature is high or the oil pressure is low. Illumination of the 42° CHIP DETR CAUTION lights, located on the pilot and copilot/gunner caution panels, indicate gearbox mounted chip detector has collected enough chips or foreign material to complete the circuit.

90 DEGREE GEARBOX CAUTION LIGHTS.

The 90 degree gearbox caution light is located in the pilot caution panel. The caution light will illuminate 90° TEMP/PRESS when the oil temperature is high or the oil pressure is low. Illumination of the 90° CHIP DETR CAUTION lights, located on the pilot and copilot/gunner caution panels, indicate gearbox mounted chip detector has collected enough chips or foreign material to complete the circuit.

ROTOR BRAKE.

The rotor brake is provided for stopping rotation of the main rotor after engine shutdown and for holding the rotor blade from turning for single engine start. The rotor brake system consists of a rotor brake handle, connecting cable, rotor brake control unit, hydraulic lines, pucks, brake discs, pressure switch, and warning light. The rotor brake lever is located left of the pilot collective stick (figure 1-14). The rotor brake control unit mounted forward of the transmission is controlled by a cable from the rotor brake handle. Brake disc and pucks are on each side of the main transmission. Hydraulic pressure to actuate the rotor brake is supplied from the No. 2 hydraulic system when the rotor is turning or by raising the rotor brake handle through the detent gate by pushing the detent gate button and pumping the handle to apply brake pressure to lock the rotor. When hydraulic pressure is applied, the pressure switch closes the circuit and illuminates and ROTOR BRAKE warning light on the pilot glare shield. Power is supplied by the 28 vdc essential bus and protected by the ROTOR BK circuit breaker.

Operation of Rotor Brake.

To apply the brake with the rotor turning, pull back on the rotor brake handle until the desired stopping rate is obtained. ROTOR BRAKE light will illuminate to indicate pressure is being applied to the rotor brake system. When rotor has slowed to approximately one half revolution per minute, pull handle against the detent stop to prevent brake pressure bleed-off.

CAUTION

Do not move rotor brake handle beyond detent to stop a turning rotor.

NOTE

Brake pressure may be varied by returning the handle to the full off position and reapplying. Maximum braking pressure available decreases with a decrease in rotor rpm. Small rotor brake handle movements around intermediate setting may result in erratic rotor brake response.

To apply rotor brake for rotor hold during engine start, push detent button and raise handle above detent gate, then release detent button. Pump handle to obtain rotor brake pressure. ROTOR BRAKE light will illuminate to indicate that pressure is being applied to the rotor brake system. Continue pumping for a minimum of six strokes after light is illuminated to assure adequate pressure is obtained.

To release rotor brake, push detent button and place handle against the forward stop. Rotor will start to turn when the handle is moved slightly forward of detent gate.

FUEL SUPPLY SYSTEM.

The fuel system consists of two interconnected rubber fuel cells. Each cell has a sump, drain valve and a submerged fuel boost pump. In addition the system has firewall shutoff valves, crossfeed

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valve, low level switches, fuel feed line check valves, boost pump pressure switches, fuel quantity transmitters and indicator, fuel pressure transmitter and indicator, filters, fuel cell interconnect valve, fittings, and connecting lines (FO-1). The crossfeed valve allows both engines to operate from either or both fuel cells.

Engine Driven Fuel Pumps.

A pump is located on the front face of each accessory gearbox, between the fuel control and gearbox cover of each engine. These pumps deliver fuel to the fuel controls. A filter is incorporated in each engine driven fuel pump.

Fuel Switch Engine 1 and Engine 2.

Fuel switches for ENG 1 and ENG 2 are located on the pilot ENGINE control panel (figure 1-15). The two-position (ON-OFF) switches are lock-in-on which must be pulled up before switch movement to OFF can be accomplished. Movement of either switch forward to ON energizes both fuel boost pumps. However, each switch must be ON to open the respective fuel valve and energize the respective igniter plugs (the START switch on the pilot collective stick must also be in ENG 1 or ENG 2 position to energize the respective igniter plugs). The ON position of each FUEL switch also energizes the fuel control heater of that engine fuel system. The OFF position of each FUEL switch turns off all respective fuel circuits except the fuel boost pumps. Both switches must be in the OFF position to turn off fuel boost pumps. Power for all fuel circuits is supplied by the 28 vdc essential bus and protected by the FUEL circuit breakers.

FUEL BOOST PUMPS.

One fuel boost pump is located in each fuel cell. The pumps are electrically operated and controlled by the ENGINE FUEL switches. Power is supplied by 28 vdc essential bus and protected by the FWD BOOST and AFT BOOST circuit breakers.

Fuel Interconnect Valve Switch.

The FUEL TANK INTCON switch is located on the pilot ENGINE control panel (figure 1-15). The OPEN position opens a valve in the connecting line between the fuel cell. The CLOSE position closes the valve so that no fuel can pass from one cell to the other. Power is supplied by the 28 vdc essential bus and protected by the FUEL VALVE circuit breaker.

NOTE

The interconnect valve is opened when either AUX FUEL switch is in PUMP, regardless of FUEL INTCON switch position.

Crossfeed Valve Switch.

The CROSSFEED valve switch is located on the pilot ENGINE control panel (figure 1-15). When the valve is open, either cell can supply both engines. With the valve closed, the forward cell supplies engine 1 only and the aft cell supplies engine 2 only. Power is supplied by the 28 vdc essential bus and protected by the FUEL VALVE circuit breaker.

Fuel Quantity Indicator.

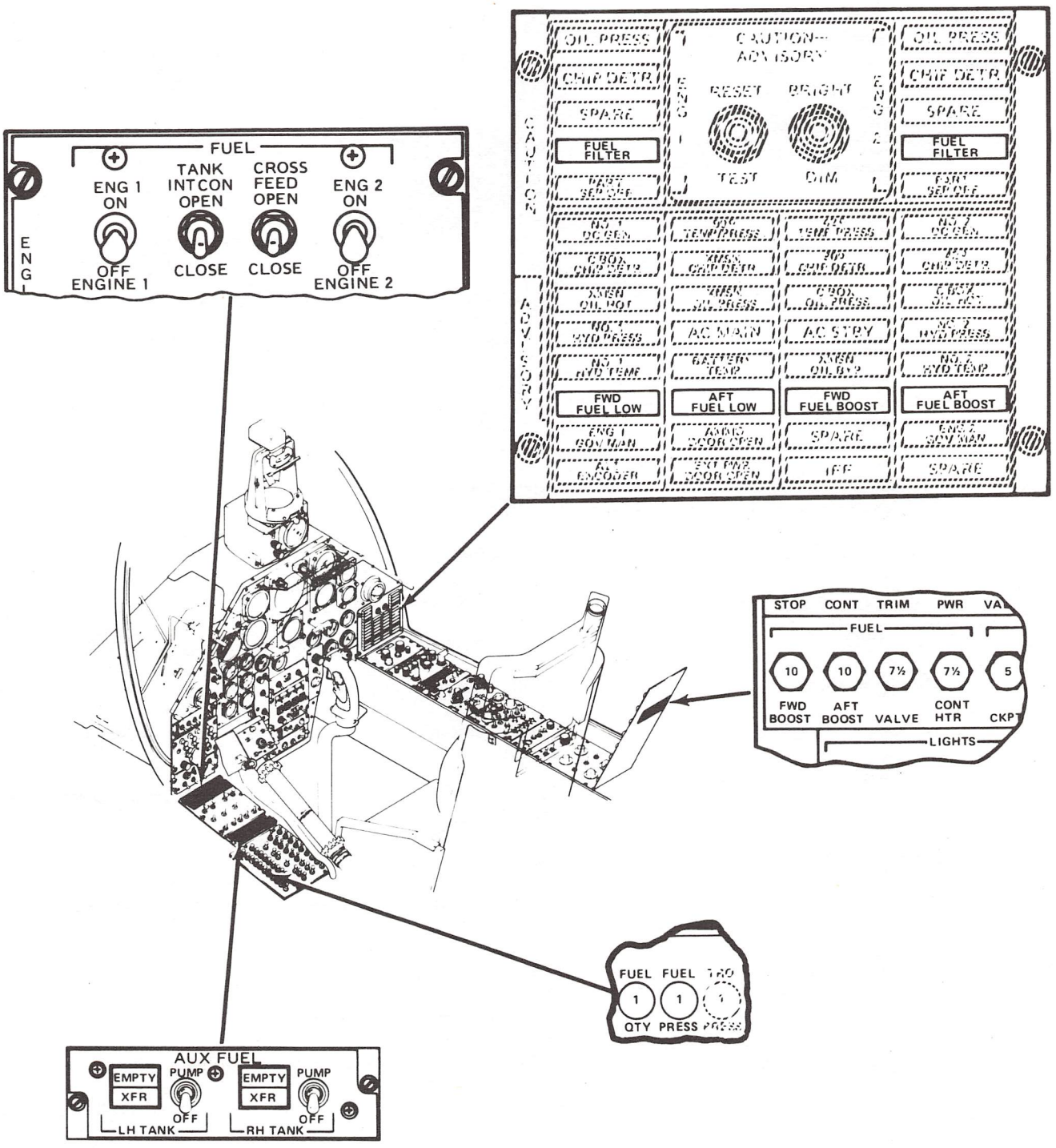
The fuel quantity indicator (figure 1-15) is located on the pilot instrument panel. This instrument indicates the quantity of fuel in both internal cells in pounds, and is connected to fuel quantity transmitters in the forward and aft cells. Power is supplied by the 115 vac essential bus and is protected by the FUEL QTY circuit breaker.

FUEL GAGE TEST SWITCH.

A push-button momentary-on FUEL GA TEST switch is located on the pilot instrument panel (figure FO-6). The switch provides a means of testing the fuel quantity indicator and circuit for operation. When the switch is depressed and held in, the fuel quantity indicator pointer moves from the actual quantity reading toward a lower quantity reading. Upon release of the test switch, the indicator needle will return to the actual reading.

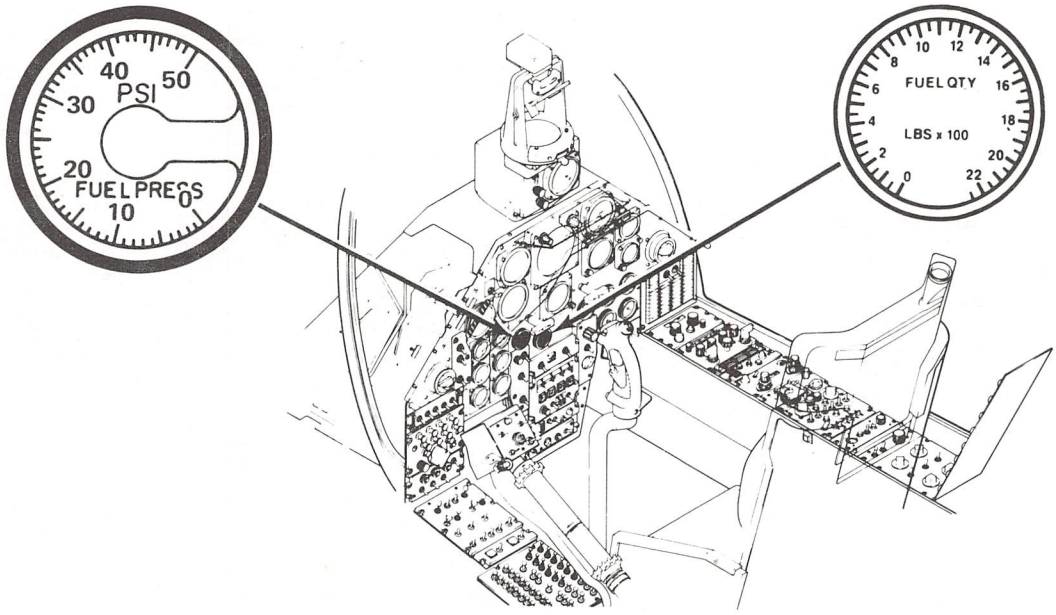
Fuel Pressure Indicator.

The fuel pressure indicator is located on the pilot instrument panel (figure 1-15). The indicator provides psi reading of fuel as delivered from the cell mounted fuel boost pumps. The indicator is connected to a pressure transmitter which transmits the fuel pressure reading to the fuel pressure indicator. With the crossfeed valve closed, only aft boost pump pressure is indicated. Power is supplied by the 26 vac essential bus and protected by the FUEL PRESS circuit breaker.



210900-115-1

Figure 1-15. Fuel System (Sheet 1 of 2)



NOMENCLATURE	FUNCTION
FUEL QTY indicator	Display fuel in pounds.
FUEL PRESS indicator	Display pressure in psi.
Caution lights	Illuminate to show fault condition.
Circuit breaker	Protect electrical circuits.
AUX FUEL switches	PUMP — activate respective transfer air pressure pump and signal interconnect valve open.
	OFF — deactivate respective transfer air pressure pump and signal interconnect valve closed.
Advisory lights	EMPTY — indicate tank is empty (yellow).
	XFR — indicate fuel being transferred to forward cell (green).
ENG 1/2 switches	ENG — activate fuel system to respective engine.
	OFF — deactivate fuel system to respective engine.
CROSS FEED switch	OPEN — allow either cell to supply either engine.
	CLOSED — forward cell supplies #1 engine, aft cell supplies #2 engine.
TANK INTCON switch	OPEN — allow fuel to flow between forward and aft cell.
	CLOSED — prevent fuel from flowing between forward and aft cell.

210900-115-2

Figure 1-15. Fuel System (Sheet 2 of 2)

Fuel System Caution Lights.

The pilot fuel system caution lights consist of (ENG 1) FUEL FILTER, (ENG 2) FUEL FILTER, FWD FUEL BOOST, AFT FUEL BOOST, FWD FUEL LOW, and AFT FUEL LOW. The gunner fuel system caution lights consist of FWD FUEL LOW, AFT FUEL LOW, ENG 1 FUEL FLTR and ENG 2 FUEL FLTR.

Forward and Aft Fuel Boost Pump Caution Lights.

The FWD FUEL BOOST and AFT FUEL BOOST caution lights are located on the pilot caution panel. Failure of a fuel boost pump illuminates the caution light for that particular boost pump.

NOTE

Failure of the aft fuel boost pump, with the fuel crossfeed valve closed, will result in a zero fuel pressure indication due to the fuel pressure transmitter being located in the fuel line from the aft cell.

Fuel Filter Caution Lights.

NEW

Caution lights for (ENG 1) FUEL FILTER and (ENG 2) FUEL FILTER are located in the pilot and copilot caution panel. Differential pressure switches are mounted in the fuel lines across each filter. When the filter becomes partially obstructed, the pressure switch senses this and closes contacts to energize the circuit and the (ENG 1) FUEL FILTER caution light, or the (ENG 2) FUEL FILTER caution light illuminates. This indicates a partially clogged filter and impending bypass condition. If clogging continues, the fuel bypass valve opens to allow fuel to bypass the clogged filter.

Forward and Aft Fuel Low Caution Lights.

Both pilot and copilot/gunner caution panels have FWD FUEL LOW and AFT FUEL LOW caution lights. Both fuel cells have low level switches which illuminate the caution lights when fuel in the cell reaches a low level. The quantity of fuel in each cell at the time a low level light illuminates depends on the flight attitude.

At 7 degrees nose down, (cruise attitude) with interconnect valve open, the AFT FUEL LOW light illuminates when 475 pounds of fuel remains, and the FWD FUEL LOW light illuminates when 140 pounds remain. With the FUEL TANK INTCON switch in the CLOSE position, these values are 625 and 160 pounds respectively.

NOTE

Nose down attitude of greater than 7 degrees will result in an AFT FUEL LOW light at higher total fuel remaining indication.

AUXILIARY FUEL SYSTEM.

There are three types of external auxiliary fuel tanks which may be installed at the wing stores stations of the AH-1T and AH-1T (TOW) helicopters. These tanks, along with associated accessory equipment mounted on the parent rack, are used in conjunction with the controls, fuel cells (tanks), advisory lights, and fuel and air distribution valves inside the aircraft. An automatic level sensing system in the aircraft forward fuel cell operates the air compressor (located either on the pylon assembly or the fuel adapter) which forces fuel out of the auxiliary tanks and into the forward fuel cell. (See figure FO-1.)

Various accessories of attaching brackets and hardware, fairings, fuel and air hoses, electrical cables, air compressors, check valves, and pressure regulators are provided to adapt the three different tanks to the particular aircraft and mounting location on the aircraft. The system is designed so that it is possible to accommodate all of the three tank systems with only minor alterations to the aircraft at the time of initial installation.

There are two types of 100 gallon tanks and one type of 77 gallon tank. Both 100 gallon types (part numbers 206K 68510-1 and 382-685001) must be installed in pairs at the outboard positions. The 77 gallon may be installed in either the inboard or outboard position, in pairs, or in all four positions.

The system using part number 206K 68510-1 (100-gallon tank), is comprised of an adapter and pylon assembly which includes the following components: an electrical air compressor, an air check valve, an air pressure regulator, all of which are installed in the pylon; fuel, air, and electrical quick disconnects to the tank for jettison separation, also installed in the pylon; and a tank empty switch installed inside the tank.

NEW

The systems using part number 382-68500-1 (100-gallon tank) or part number 386-68500-1 (77-gallon tank) is comprised of a fuel adapter and bracket arrangement which includes the following components: an electrical air compressor, air check valve, and an air pressure regulator, all of which are installed in the fuel adapter; and fuel, air, and electrical quick disconnects to the tank for jettison separation, also installed in the fuel adapter; and a tank empty switch installed inside the tank.

A cockpit mounted PUMP/OFF switch is provided for each auxiliary tank. When the switch is placed in PUMP, fuel will transfer from the auxiliary tank to the forward fuselage tank.

A crossfeed system is provided in the air pressurization system so that one air pump can pressurize both auxiliary fuel tanks if a failure of one pump occurs. A shutoff valve is installed in the air feed line to allow operation of only one tank.

Press-to-test lights in the cockpit indicate when fuel is transferring and when tanks are empty. XFR advisory indicator lights operate when fuel is flowing through a flow indicating check valve. EMPTY caution lights indicate when each tank is empty.

PRESSURE FUELING.

The pressure fueling system will accept the standard pressure fueling probe and is capable of receiving fuel at a rate of 45 gallons per minute at 55 psi (figure 1-16). The system consists of a receiver located in the right side of the aft fuel cell, a dual level control valve in the forward cell, a dual shutoff valve, and two press-to-test precheck valves. The level control valve senses a full tank and causes the shutoff valve to close thus stopping the fueling operation. Proper operation of the level control and shutoff valves are checked during filling by pressing the precheck valves in turn which actuates the level control valve and thus causes the shutoff valve to close.

DC POWER SUPPLY SYSTEM.

The primary electrical power supply system is a 28-volt direct current single-wire, negative-ground, dual bus arrangement supplied by 30-volt, 200 ampere starter-generators, one mounted on each engine. The system is designed so that in the event of failure of one generator the remaining generator will supply the electrical load. The dual-bus power distribution system allows the nonessential loads

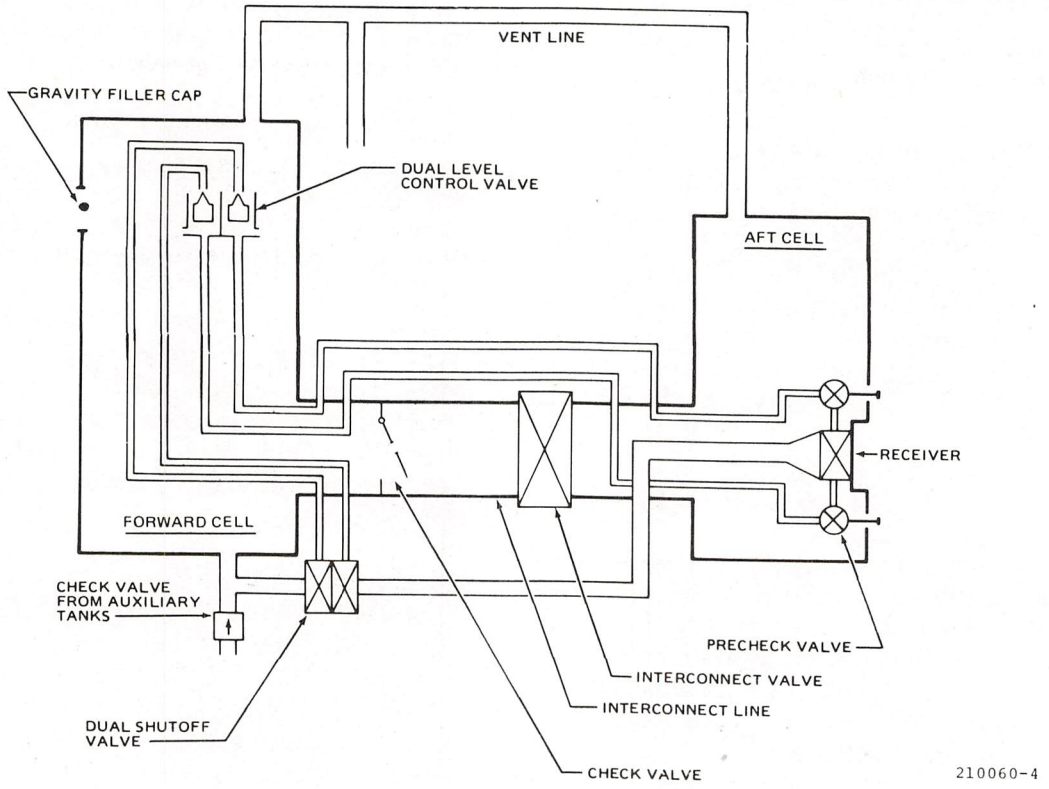


Figure 1-16. Pressure Fueling Schematic

to be automatically deenergized in event of failure of both generators (figure 1-17). The battery then supplies the essential bus load. Manual selection capability allows the nonessential bus to be reactivated at pilot discretion. Power for turret control and firing is supplied by the No. 2 generator when the MASTER ARM switch is in the STBY or ARM position. Under these conditions, power to the main bus is supplied by the No. 1 generator. In the event of failure of the No. 2 generator while supplying turret power, the No. 1 generator will automatically switch to supply turret power. The main bus is then supplied by the battery.

DC Power Control.

The dc power is controlled by the battery switch, generator switches, nonessential bus switch, and dc circuit breakers.

DC POWER CONTROL PANEL.

This panel is marked POWER and is part of the ENGINE control panel. The panel contains the following control switches; NO. 1 GEN, NO. 2 GEN, INVERTERS, NON-ESS BUS and BATTERY. Panel illumination is provided by a panel light that is controlled from a rheostat switch in the LIGHTS panel (figure 1-31).

Battery.

A 24-volt, 34 ampere-hour battery, located in the electrical compartment, provides power for starting when a battery start is necessary. The battery also provides a backup source of power in the event of generator failure. Assuming 85 percent charge, the battery can supply the essential dc loads for a period of approximately 16 to 32 minutes depending on equipment in use. 22 vdc is minimum for battery start.

NEW

BATTERY SWITCH.

The switch is a two-position switch labeled BATTERY (figure 1-17). Battery power is supplied to the electrical system when the switch is in the ON position. Placing the switch to OFF removes battery power from the system. The copilot/gunner is provided a two-position ELEC PWR/EMER OFF switch on the miscellaneous control panel to provide a means of deenergizing the electrical system and the generator circuit.

Generator.

The starter-generators are located on the front of each engine accessory gearbox. These are 30-volt, 200 ampere generators that deliver regulated power when gas producer turbine rpm is approximately 71 percent or above. Electrical power is distributed by a dual bus arrangement. The generator voltage regulator automatically controls the generator field current to maintain the proper generator output voltage of 27 to 28.5 vdc. The generator reverse current relay automatically opens the circuit from the generator to main dc bus when battery voltage is greater than generator voltage, preventing discharge of the battery through the generator. The generator is protected by the generator field circuit breaker.

GENERATOR SWITCHES NO. 1 AND NO. 2.

These switches are located on the pilot POWER control panel (figure 1-17). The switches are labeled NO. 1 GEN and NO. 2 GEN. Both switches are normally in the ON position. The RESET position is spring loaded to return to the OFF position. To reset the generator, the switch must be held in the RESET position momentarily and then moved to the ON position. The reset circuit is protected by the GEN BUS RESET circuit breaker.

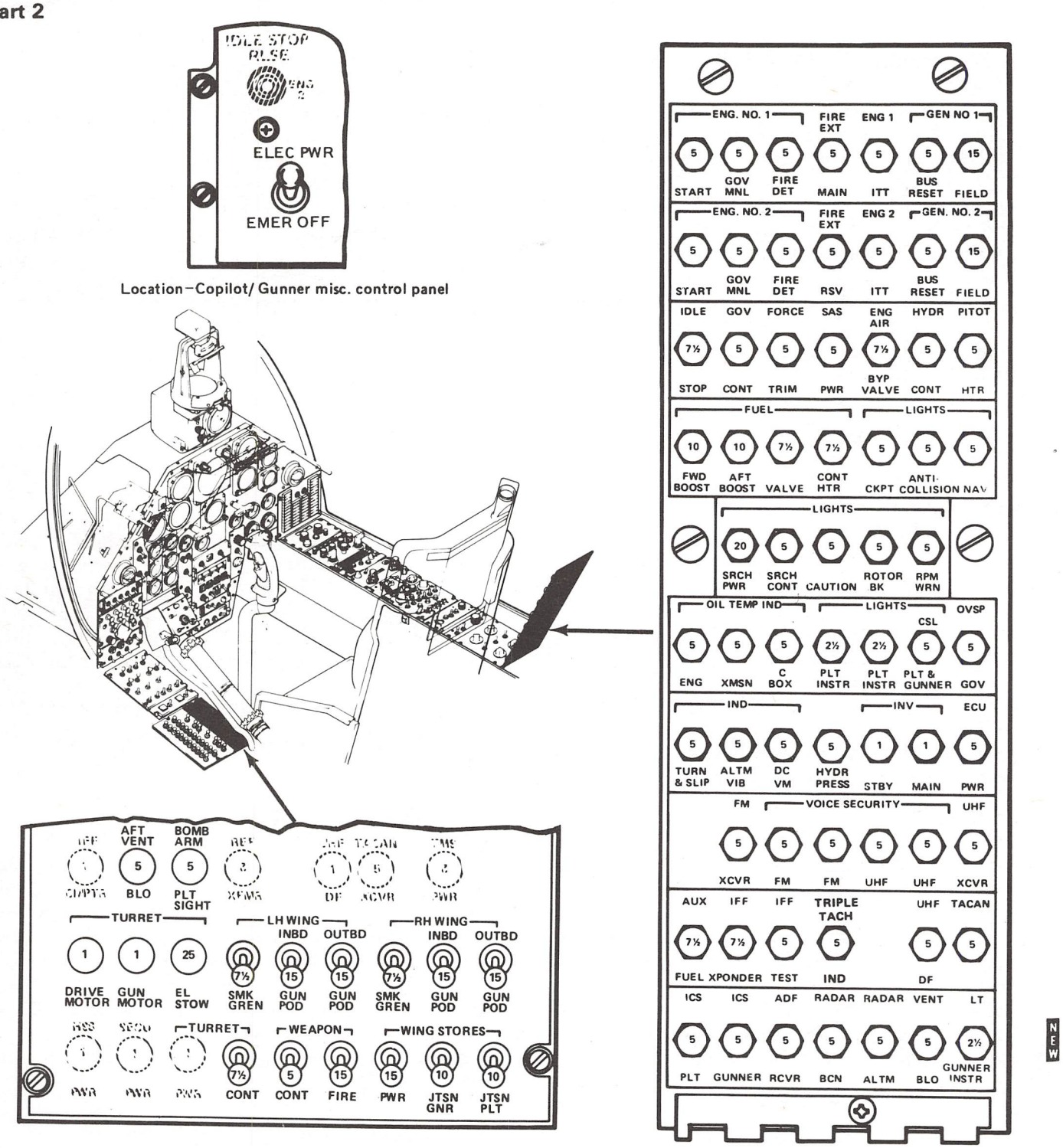
NEW

GENERATOR CAUTION LIGHTS.

The No. 1 DC GEN and NO. 2 DC GEN caution lights are located on the pilot and copilot/gunner caution panels. The lights are controlled by the reverse current relays for each generator. When a relay is open, the light illuminates and the generator switch should be held in the RESET position momentarily and then moved to ON in an attempt to bring the generator back on the line. When the generator starts operating, the light will extinguish.

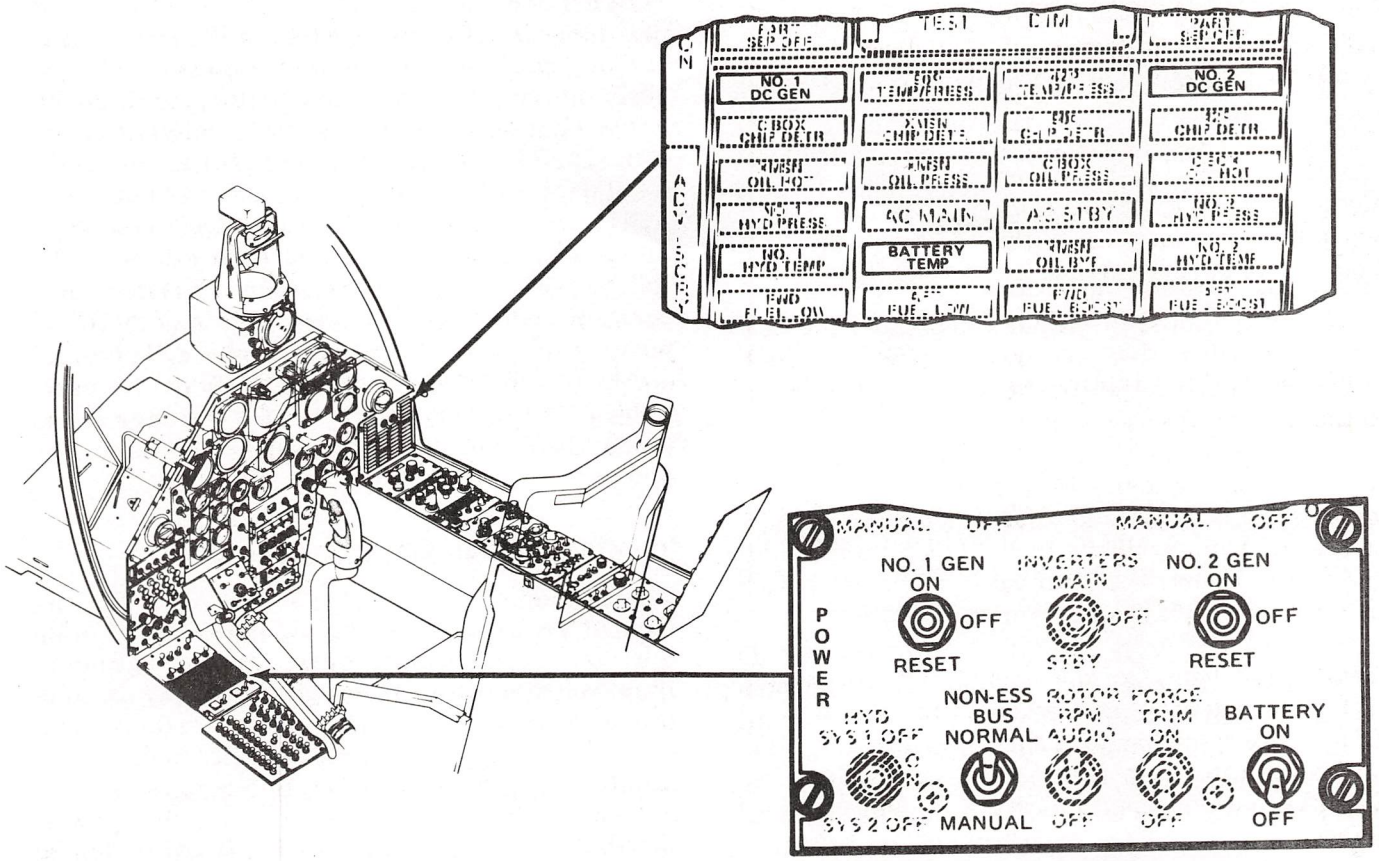
Nonessential Bus Switch.

The NON-ESS BUS switch is located on the pilot POWER control panel. When the switch is in NORMAL, power is supplied to the nonessential bus as long as either generator is operating. In the event of a dual generator failure, the nonessential bus can be reclaimed by placing the switch to MANUAL. In all normal flight operations the switch shall be in the NORMAL position.



210900-117-1

Figure 1-17. DC Power Supply (Sheet 1 of 2)



NOMENCLATURE	FUNCTION
GEN switch	ON — activates respective generator OFF — deactivates respective generator RESET — flashes respective generator field
NON-ESS BUS	NORMAL — removes nonessential items from electrical circuit if generators fail MANUAL — allows battery operation of all electrical circuits if generators fail
Caution lights	Illuminates to show fault condition
Circuit breakers	Protects respective circuit

NOTE

Armament DC circuit breakers are located on the AC circuit breaker panel.

210900-117-2

NEW

Figure 1-17. DC Power Supply (Sheet 2 of 2)

DC Circuit Breaker Panel.

The dc circuit breaker panel is located on the pilot right console (figure 1-17). Each individual circuit breaker is labeled for the particular circuit protected. In the event a circuit is overloaded, that circuit breaker will pop out. The circuit is activated by pushing the circuit breaker in.

Electrical System Indicators.

The electrical system indicators consist of a dual ammeter and a combination ac and dc voltmeter.

DUAL AMMETER.

The dual ammeter is two ammeters in one case. The AMPS instrument is installed in the pilot instrument panel. The ammeters are marked 1 and 2 and indicate generator amperage output.

AC AND DC VOLTMETER. The ac and dc voltmeters are combined in one case, marked VOLTS, and installed in the pilot instrument panel. The left section of the voltmeter is marked AC and represents the voltage on the 115 vac essential bus. The right section is marked DC and represents the voltage on the 28 vdc main bus.

AC POWER SUPPLY SYSTEM.

AC power is supplied for instrument and avionics equipment by the 115 volt, 1,000 volt-ampere, static main inverter. Power is supplied from the 28 vdc essential bus, but is controlled by the 28 vdc nonessential bus. A 750 volt-ampere static inverter is provided as a standby. The standby inverter also receives power from the 28 vdc essential bus. The ac power is also distributed by a dual bus system, such that the 26 vac and 115 vac nonessential buses are de-energized in the event of failure of the main inverter. The standby inverter can be manually actuated to provide power to the ac essential buses.

AC Power Control.

The ac power is controlled by the INVERTERS switch and the ac circuit breakers on the ac/armament circuit breaker panel.

Inverters Switch.

The three-position (MAIN/OFF/STBY) INVERTERS switch is located on the pilot POWER control panel (figure 1-18). In the MAIN position, the main inverter is on if electrical power is being supplied by one or both generators. The main inverter will also be on in this position with APU or battery power if the NON-ESS BUS switch is in MANUAL. With the NON-ESS BUS switch in NORMAL with both generators off and battery or APU power applied, the standby inverter is powering the system regardless of the INVERTERS switch position. In the OFF position, both inverters are off. In the STBY position, the standby inverter is on. Under normal conditions the switch is in MAIN. When the main inverter is not operating, the 26 vac nonessential bus and the 115 vac nonessential bus receive no power.

Inverter Caution Lights.

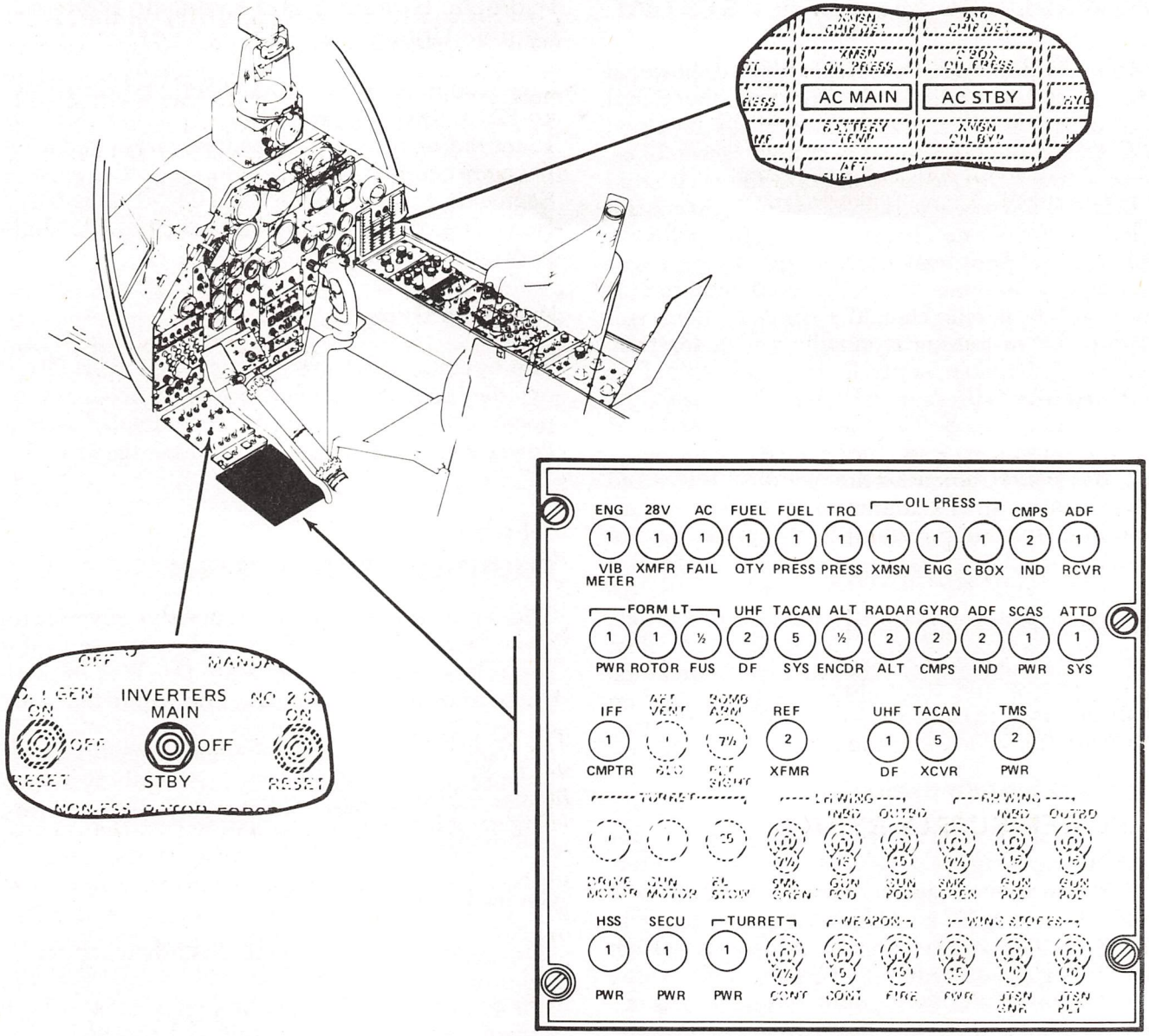
The caution lights AC MAIN and AC STBY are located on the pilot and copilot/gunner caution panels. The appropriate caution light is illuminated when ac power from either inverter to the ac essential bus is lost.

AC/Armament Circuit Breaker Panel.

The ac/armament circuit breaker panel is located on the pilot left-hand console (figure 1-18). Circuit breakers of the push-pull type are pushed down to energize and pulled up to de-energize the related circuits. Circuit breaker switches are placed outboard to energize and inboard to de-energize the related circuit. In the event of a current overload the related circuit breaker or circuit breaker switch will be forced up or inboard and must be reset.

EXTERNAL POWER RECEPTACLE.

The external power receptacle is located on the left side of the fuselage. When a 28 vdc auxiliary power unit plug is inserted in the receptacle, the external power relay in the electrical system is energized and 28 vdc electrical power is supplied to the primary bus. When the external door is opened, the EXT PWR DOOR OPEN advisory light will illuminate on the pilot caution panel. A voltage sensor is provided in the electrical compartment which prevents the external power from being supplied to the helicopter bus if the APU is not set within the limits of 26-29 vdc. The sensor will automatically disconnect the helicopter bus from APU if voltage moves out of limits or excessive transients are present. NEW



NOMENCLATURE	FUNCTION
Caution lights	Illuminate to show fault condition
Circuit breaker	Protect individual circuits
INVERTERS switch	MAIN — activates main inverter
	OFF — deactivates inverters
	STBY — activates standby inverter

210900-124

Figure 1-18. AC Power Supply

HYDRAULIC POWER SUPPLY SYSTEM.

Two hydraulic systems are provided for powered control of the cyclic, collective and directional control system. Each system employs identical reservoirs, modules and manifold assemblies. Both systems are used to operate the cyclic and collective dual power actuators in the flight control system, there is no physical connection between the systems. Each system uses separate passages and piston chambers inside the dual actuators. If one system is disabled, the other system will supply the necessary hydraulic power for fully normal helicopter control. Hydraulic fluid is supplied from a pressurized reservoir to the pump. The pumps deliver 3000 psi output pressure at normal operating rpm. Hydraulic System No. 1 supplies system power for the cyclic, collective and directional control actuators and the yaw SCAS actuator. Hydraulic system No. 2 supplies system power for the cyclic and collective control actuators and for the pitch and roll SCAS actuators, pylon actuators, and the rotor brake. Hydraulic system indicators are hydraulic system fluid level sight gages, clogged filter indicators, pressure indicator and related system caution light. See figure FO-2.

Hydraulic System Switch.

The hydraulic system switch is located on the pilot POWER panel (figure 1-19). The switch is a three-position lock-in-on switch labeled HYD SYS 1 OFF, ON and SYS 2 OFF. When the switch is in SYS 1 OFF position, system 2 is the only system that is supplied hydraulic pressure. When the switch is in SYS 2 OFF position, system 1 is the only system that is supplied hydraulic pressure. When the switch is in the ON position, both systems are supplied hydraulic pressure.

Fluid Level Sight Gage.

The reservoir for each system has a sight gage. The sight gage gives a direct indication of the hydraulic fluid level in that reservoir.

Hydraulic Filter and Indicator.

The filter assembly incorporates a red indicator that raises when the differential pressure across the filter element exceeds 70 psi. Once extended, the indicator will remain so until manually depressed. When the indicator is in the retracted (reset) position, it is hidden from view.

Hydraulic System 1 and Hydraulic System 2 Caution Lights.

The caution panels contain segments labeled NO. 1 HYD PRESS and NO. 2 HYD PRESS. Illumination of either segment indicates that a low pressure condition exists in the respective system. Segments labeled NO. 1 HYD TEMP and NO. 2 HYD TEMP are provided to indicate high hydraulic oil temperature.

Hydraulic Gage.

The hydraulic pressure gage, marked HYD PSI, is on the pilot instrument panel. It indicates psi pressure of No. 1 and No. 2 hydraulic system. Power is supplied by the 28 vdc essential bus. NEW

FLIGHT CONTROL SYSTEM.

The flight control system is a positive mechanical type, actuated by cyclic, collective, and tail rotor controls. Complete controls are provided for both pilot and copilot/gunner. The copilot/gunner controls are slaved to the pilot controls (figures 1-20/foldout 5). The system includes a cyclic system, a collective control system, a tail rotor system, a force trim system, a stability and control augmentation system (SCAS).

Cyclic Control System.

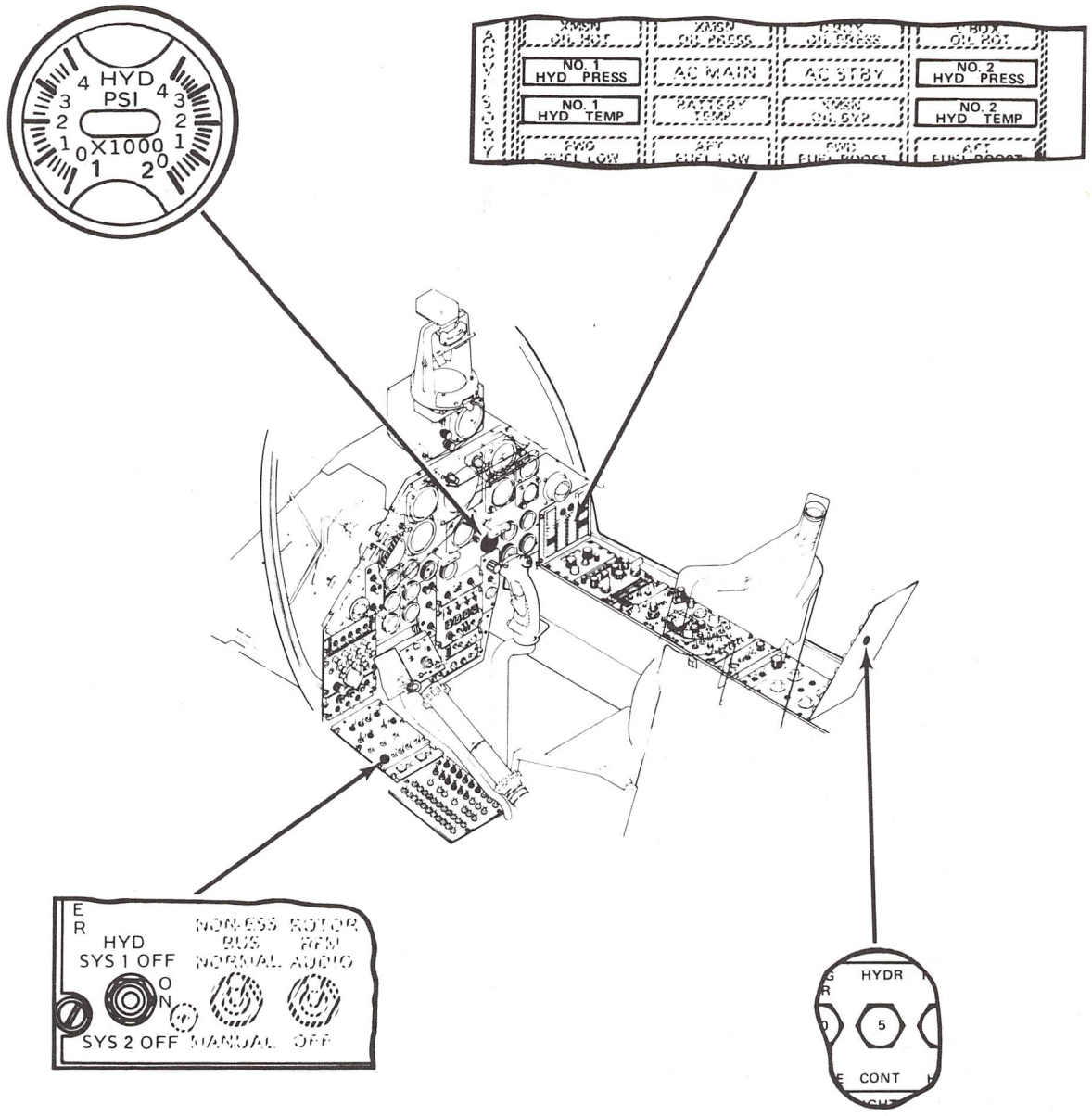
The system is operated by the cyclic stick (figure 1-20) movement. Moving the stick in any direction will produce a corresponding movement of the helicopter which is the result of a change in the plane of rotation of the main rotor. The stick fore and aft movement also changes the synchronized elevator attitude to assist controllability and lengthens cg range.

Collective Control System.

The system is operated by the collective stick (figure 1-20). Moving the stick up or down changes the angle of attack and lift developed by the main rotor resulting in the ascent or descent of the helicopter.

Tail Rotor Control System.

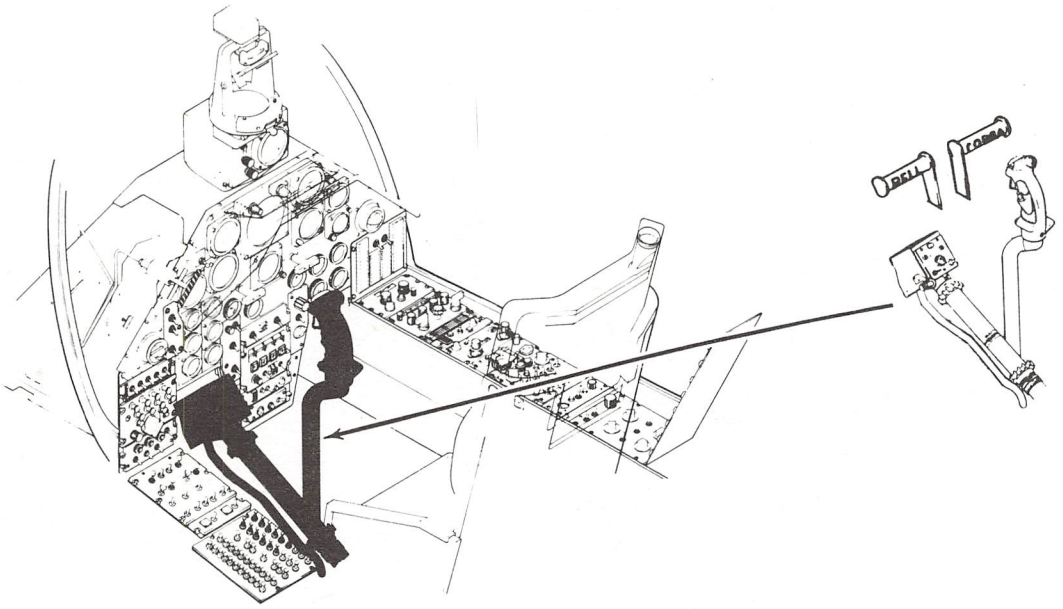
The system is operated by the pedals (figure 1-20). Pushing a pedal changes the pitch of the tail rotor



NOMENCLATURE	FUNCTION
HYD PSI	Indicate psi of No. 1 and No. 2 system.
Caution panel	Illuminate to show fault condition.
Circuit breaker	Protect electrical circuit.
HYD switch	Controls system No. 1 or No. 2.

210900-123

Figure 1-19. Hydraulic System



NOMENCLATURE	FUNCTION
Cyclic	Position tip path plane.
Collective	Change pitch in main rotor.
Directional pedals	Change pitch in tail rotor.

210900-122

Figure 1-20. Flight Controls

resulting in directional control and may be used to pivot the helicopter on its own vertical axis. A pedal adjuster is provided to adjust the pedal distance for individual comfort. Heel rests are provided for the copilot/gunner to prevent inadvertent pedal operation.

Force Trim System.

The system incorporates magnetic brakes and force gradient springs in the cyclic and directional control systems to provide artifical feel in the systems. Depressing the cyclic stick force trim switch will cause the magnetic brake and force gradient to be repositioned to correspond to the positions of the cyclic stick and pedals thus providing trim. FORCE TRIM (Pilot), F TRIM (copilot/gunner) switches are provided. The pilots switch is located on the pilot POWER panel and the copilot/gunner switch is located on the gunners miscellaneous control panel. The ON position actuates the system. The OFF position of either switch de-activates the system. Power is supplied by the 28 vdc essential bus and protected by the FORCE TRIM circuit breaker.

STABILITY AND CONTROL AUGMENTATION SYSTEM (SCAS).

Description.

The SCAS is a three-axis, limited authority stability and control augmentation system (foldout 5). The system utilizes rate gyros and control motion sensors to provide a well dampened helicopter that is also responsive to pilot inputs. The inputs are accomplished by electro-hydraulic servo actuators installed in series with the control system. The inputs are not felt at the pilot stick. A hydraulic interlock automatically disengages the appropriate channels in the event of a hydraulic system failure.

Control Panel.

The SCAS control panel (figure 1-21) contains a POWER switch for applying 28 vdc (essential bus) and 115 vac operating voltages to the system. The circuits are protected by the SAS PWR dc and SCAS PWR ac circuit breakers. The panel also contains three magnetically held channel engage switches which energize electric solenoid valves controlling hydraulic pressure to the system. The panel has three NO-GO lights; one each associated with PITCH, ROLL, and YAW channel engage switches. These lights are illuminated during the warmup to indicate the presence of current in each associated actuator channel. Should an engagement be attempted during this warmup period, the actuator will make an abrupt input to the flight controls at the moment of engagement. When engagement is made, the NO-GO lights are locked out of the circuit and do not operate as malfunction indicators. Disengaging a channel, however, restores the associated light to operation. The NO-GO lights have a built-in press-to-test feature for ensuring that the indicator is operational, but this feature works only prior to channel engagement.

SCAS (SAS) Release Switch.

The cyclic grip mounted switch (figure 1-21) is used to disengage the pitch, roll, and yaw channels simultaneously. The channels are re-engaged by the PITCH, ROLL and YAW switches on the SCAS control panel.

SYNCHRONIZED ELEVATOR.

The synchronized elevator is located near the aft end of the tailboom and is connected by control tubes and mechanical linkage to the fore and aft cyclic control system (figure 1-1). Fore and aft movement of the cyclic stick produces a change in the synchronized elevator attitude, thus increasing controllability and cg range.

LANDING GEAR SYSTEM.

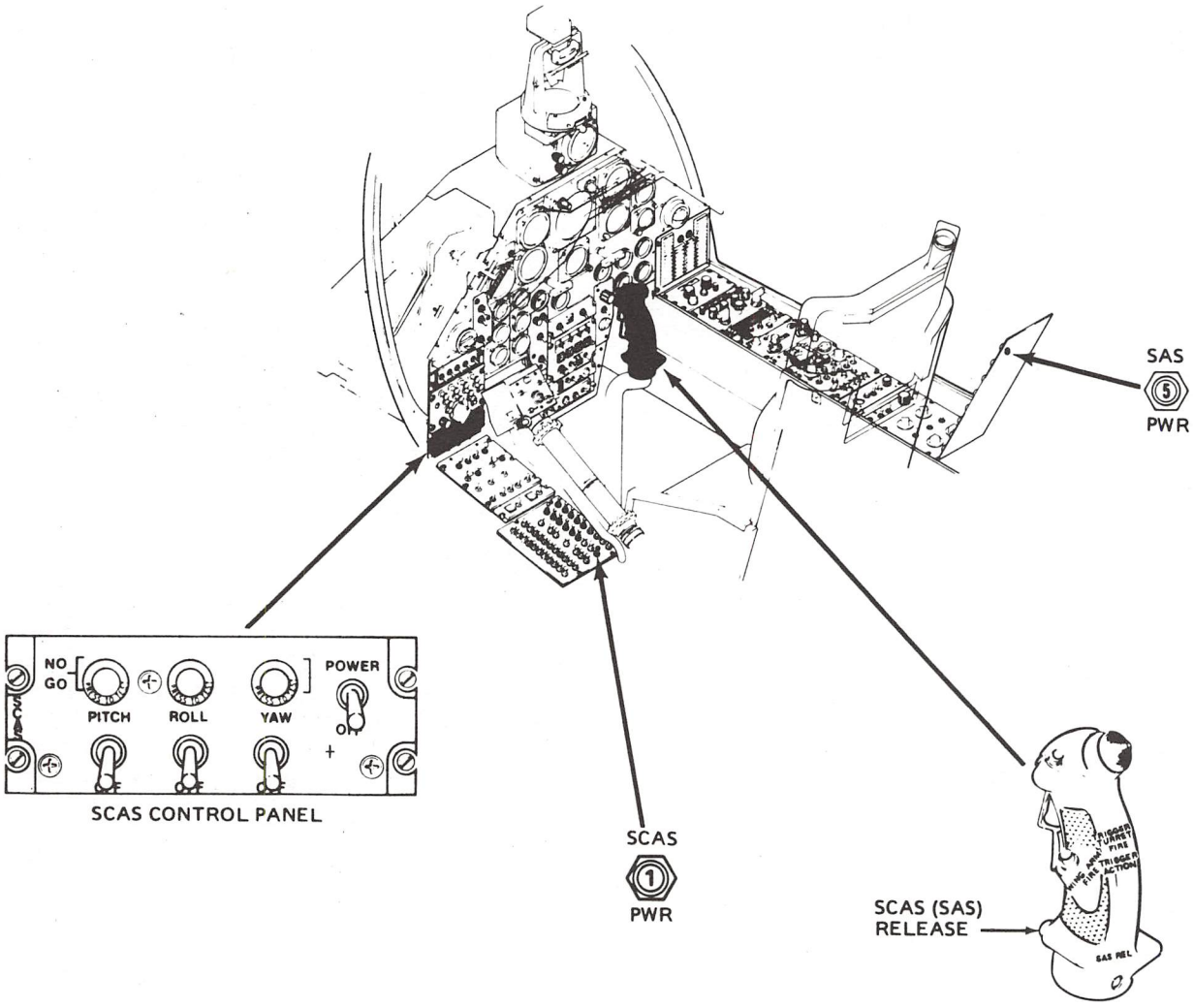
The landing gear system is a skid type, consisting of two lateral mounted arched crosstubes attached to two formed longitudinal skid tubes.

TAIL SKID.

A tail skid is attached to the lower aft section of the tailboom assembly (figure 1-1). The tail skid reduces damage to the tailboom and tail rotor plus acts as an indicator to the pilot in case of a tail low landing.

INSTRUMENTS.

The flight instruments, navigation instruments and miscellaneous instruments and indicators are described in the following paragraphs. The



NOMENCLATURE	FUNCTION
NO GO indicator	Illuminated — Red — channel not ready for engagement.
POWER switch	OFF — deactivate system.
	POWER — activate system.
PITCH, ROLL, YAW switches	Up — activate respective channel.
	OFF — deactivate respective channel.
Circuit breakers	Protect electrical circuit.
SCAS (SAS) RELEASE button	Deactivate pitch, roll, and yaw channels.

210900-121

Figure 1-21. Stability and Control Augmentation System (SCAS)

description of engine instruments, transmission instruments and rotor instruments will be found with the respective descriptions of the engine, transmission and rotor. Refer to Section 7 for flight instruments.

Airspeed Indicator.

The airspeed indicators are calibrated in knots and provide an indicated forward airspeed. The instrument does this by measuring the difference between impact air pressure from the pitot tube and static air pressure from the static vents. The pitot tube is mounted on the pylon fairing (figure 1-1) and the static vents are located in the side cabin skins near the bottom edge of the canopy and just aft of the copilot/gunner station. A pitot heater is provided for removal of ice or snow from the pitot tube.

Vertical Velocity Indicator.

The vertical velocity indicator indicates rate of change of altitude in feet per minute. The instrument is actuated by the rate of atmospheric pressure change and is vented to the static air system.

Altimeter.

The altimeter furnishes direct readings of height above sea level. It is vented to the static air pressure system and determines altitude from the atmospheric pressure. The pilot altimeter provides an electrical signal to the transponder for altitude reporting.

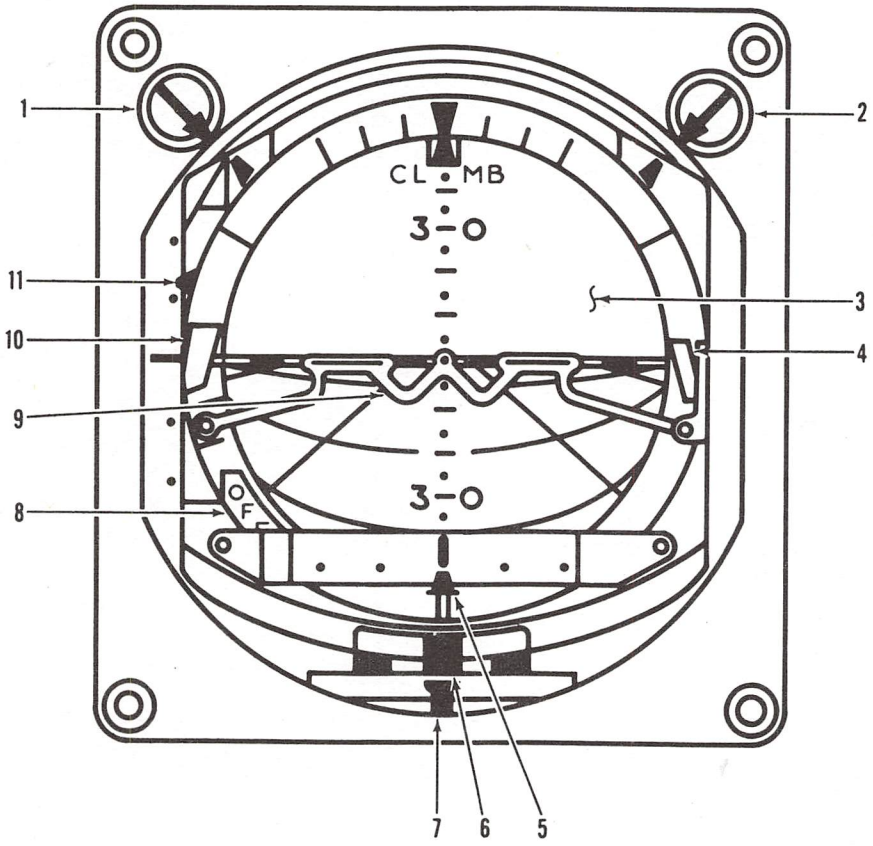
Pilot Attitude Indicator.

The pilot attitude indicator (figure 1-22) is located in the pilot instrument panel. The attitude indicator provides the pilot with a visual indication of the pitch and roll flight attitude of the helicopter in relation to the earth's horizontal plane. Pitch attitude is indicated by motion of the sphere in relation to the miniature airplane. Roll attitude is indicated by motion of the roll pointer with respect to the fixed roll scale located at the top of the display. The indicator sphere can be adjusted to zero indication by the pitch and roll trim knobs located on the face of the instrument. The turn and slip portion of the pilot attitude indicator consists of a rate of turn pointer and an inclinometer (ball) which operate independently of each other. The electrically actuated rate of turn pointer is controlled by the dc powered rate gyro. It indicates in which direction and at what rate the helicopter is turning. The inclinometer indicates when the helicopter is balanced in flight. If the helicopter is yawing or slipping the ball will be off center. Just above the ball, at the six o'clock position is a scale and a pointer which will deviate toward the FM station when the FM control panel mode selector switch is in the HOME position and the FM radio is tuned to an FM station and receiving a usable signal. When the pointer is centered in this situation, the helicopter is on a relative heading to or from the FM station. NEW

This pointer will indicate TACAN course deviation when the FM mode selector switch is in any position other than HOME and there is a usable TACAN signal being received by the TACAN receiver. In this situation, the pointer will indicate five degrees deviation from the selected TACAN radial for each dot of pointer deflection from center. When the pointer is centered in this situation, the helicopter is on the selected TACAN radial. The flag for this pointer is at the three-thirty o'clock position and will appear when the instrument is not receiving a usable signal in its selected mode. At the nine o'clock position on the periphery of the instrument is a scale and a pointer which indicates FM homing signal strength. As the helicopter approaches the station, the pointer will move toward the center of the scale. When the system is not in the FM homing mode the pointer will rest at center scale but will be accompanied by an adjacent warning flag. NEW

The horizontal deviation and vertical deviation pointers are connected to FM homing. The horizontal deviation pointer is also connected to the homing portion of the TACAN set. The horizontal deviation pointer is centered when the helicopter is on course, if FM homing or TACAN is operating. The pointer deviates to the right or left as the helicopter moves off course. As the helicopter approaches the station and the signal becomes stronger the vertical deviation pointer will move upward when the FM radio is turned to an FM station and is in the homing mode. The TACAN set is not connected to the vertical deviation pointer.

Three warning flags are incorporated in the attitude indicator. The flag centered on the left side of the indicator is the vertical deviation warning flag, and the flag centered on the right side of the



210077-32

1. PITCH TRIM
2. ROLL TRIM
3. SPHERE
4. HORIZONTAL DEVIATION FLAG (FM AND TACAN)
5. HORIZONTAL DEVIATION POINTER (FM AND TACAN)
6. INCLINOMETER
7. RATE-OF-TURN POINTER
8. POWER OFF FLAG
9. MINIATURE AIRCRAFT
10. VERTICAL DEVIATION FLAG (FM)
11. VERTICAL DEVIATION POINTER (FM)

Figure 1-22. Pilot Attitude Indicator

indicator is the horizontal deviation warning flag. These flags disappear from view when the respective pointers they represent are receiving a reliable signal. The other flag labeled OFF appears in view when electrical power to the instrument is off. Power is supplied by the 115 vac essential bus and protected by the ATTD SYS circuit breaker. Power for the integral lighting is received from the 5 vdc lighting power supply.

Copilot/Gunner Attitude Indicator.

The attitude indicator is located on the copilot/gunner instrument panel. This instrument is a repeater type instrument that repeats the information presented on the pilot instrument. The FM homing and TACAN functions are not connected and not functional on the copilot/gunner attitude indicator. No turn needle or roll trim knob is provided. Power is supplied by the 115 vdc essential bus and protected by the ATTD SYS circuit breaker. The integral lighting receives power from the 5 vdc lighting power supply.

Stand-By Compass.

A standard magnetic type compass is mounted on the left windshield support.

Free Air Temperature Indicator.

The free air temperature indicator is located on the left side of the pilot compartment. The indicator provides a direct reading of the outside air temperature.

EMERGENCY EQUIPMENT.

Pilot Master Caution System.

The pilot master caution system consists of a segmented word CAUTION ADVISORY panel and a remote MASTER CAUTION light.

MASTER CAUTION LIGHT.

The pilot MASTER CAUTION light is located at the top of the glare shield. When the aviation yellow light illuminates, the pilot is alerted to check the caution panel for the malfunction. Placing the caution panel switch to RESET will extinguish and reset the MASTER CAUTION light for subsequent caution indications.

PILOT CAUTION PANEL.

The caution panel is located in the right section of the instrument panel. When illuminated, the worded segment in the panel will be aviation yellow or green (figure 1-23). When not illuminated, the lettering will not be legible. Illumination of any of the worded segments in the caution panel alerts the pilot to malfunctions. The caution panel is equipped with a RESET-TEST switch, a BRIGHT-DIM switch and two edge lights for illuminating the switches. Power is supplied by the 28 vdc essential bus and protected by the CAUTION LIGHTS circuit breaker.

BRIGHT-DIM SWITCH. The BRIGHT-DIM switch on the pilot caution panel permits the pilot to manually select a bright or dim condition for all caution panel lights, MASTER CAUTION light, ROTOR BRAKE light, RPM light, pilot armament control, rocket control, fire warning lights in FIRE PULL handles and RADAR ALTITUDE LOW light. The intensity of the FIRE warning lights located on the copilot/gunner glare shield is also controlled by this switch. After each initial application of power, the lamps will come on bright. Momentarily placing the switch in the BRIGHT position selects the bright condition and DIM position selects dim condition.

NOTE

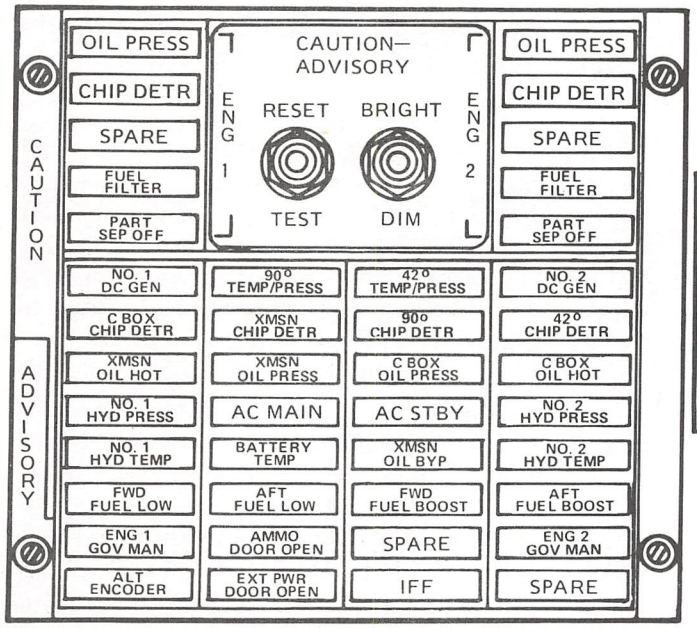
The dim function will operate only when the pilot instrument lights are on.

RESET-TEST SWITCH. The pilot caution panel has a RESET-TEST switch. The TEST position illuminates the entire caution light system. Testing the system will not change any malfunction indication existing prior to testing. The RESET position extinguishes the MASTER CAUTION lights in both cockpits in preparation for subsequent malfunctions.

Copilot/Gunner Caution Panel.

The caution panel is located on the copilot instrument panel. This is a repeater type panel and does not contain as many lights as the pilot's panel. The copilot has a MASTER CAUTION light located on the instrument glare shield. The pilot controls the RESET function of the copilot MASTER CAUTION light. The BRIGHT-DIM switch and TEST switch are located on the instrument panel.

BRIGHT-DIM SWITCH. The BRIGHT-DIM switch enables the copilot to select a bright or dim condition for all caution panel lights, MASTER CAUTION light, RPM light and copilot armament panel.



PILOT

NO. 1 DC GEN	NO. 2 DC GEN	SPARE	SPARE	SPARE	SPARE
ENG 1 CHIP DETR	ENG 2 CHIP DETR	XMSN OIL PRESS	XMSN OIL HOT	C BOX OIL PRESS	C BOX OIL HOT
ENG 1 GOV MAN	ENG 2 GOV MAN	AC MAIN	AC STBY	FWD FUEL LOW	AFT FUEL LOW
ENG 1 FUEL FLTR	ENG 2 FUEL FLTR	NO. 1 HYD PRESS	NO. 2 HYD PRESS	NO. 1 HYD TEMP	NO. 2 HYD TEMP
ENG 1 OIL PRESS	ENG 2 OIL PRESS	42° CHIP DETR	90° CHIP DETR	C BOX CHIP DETR	XMSN CHIP DETR

COPILOT/GUNNER

*Only on pilot panel
**Segments aviation green

PANEL WORDING	FAULT CONDITIONS
OIL PRESS	Respective engine oil pressure below operating minimum.
CHIP DETR	Metal particles in respective engine.
FUEL FILTER	Fuel filter partially obstructed.
*PART SEP OFF	Particle separator door not full open (respective engine).
*NO. 1-2 DC GEN	Respective DC generator failed or off.
*90 DEGREE TEMP/PRESS	Oil over temperature or pressure.
*42 DEGREE TEMP/PRESS	Oil over temperature or pressure.
C BOX CHIP DETR	Metal particles in combining gearbox.
XMSN CHIP DETR	Metal particles in transmission.
90 DEGREE CHIP DETR	Metal particles in 90 degree gearbox.
42 DEGREE CHIP DETR	Metal particles in 42 degree gearbox.
XMSN OIL HOT	Oil overtemperature.
XMSN OIL PRESS	Transmission oil pressure below operating minimum.

210075-207-1

Figure 1-23. Caution Advisory Panels (Sheet 1 of 2)

PANEL WORDING	FAULT CONDITIONS
C BOX OIL PRESS	Combining gearbox oil pressure below operating minimum.
C BOX OIL HOT	Oil overtemperature.
NO. 1-2 HYD PRESS	Respective hydraulic pressure below operating minimum.
NO. 1-2 HYD TEMP	Respective hydraulic fluid overtemperature.
*BATTERY TEMP	Battery overheating.
*XMSN OIL BYP	Oil bypassing oil cooler.
FWD-AFT FUEL LOW	Respective fuel cell quantity low.
*FWD-AFT FUEL BOOST	Respective fuel boost pump pressure low.
**ENG 1-2 GOV MAN	Respective engine governor operating in manual mode.
**AMMO DOOR OPEN	Ammunition compartment door open.
**ALT ENCODER	Electrical power lost to altimeter encoder (This light is non-functional if the AAU-32A altimeter is installed).
**EXT PWR DOOR OPEN	External power door open.
**IFF	Kit 1A zeroized.
AC MAIN	Loss of main inverter power.
AC STBY	Loss of standby inverter power.

210075-207-2

Figure 1-23. Caution Advisory Panels (Sheet 2 of 2)

NOTE

The DIM function will operate only when the copilot instrument lights are on. The copilot TURRET STOW light cannot be dimmed unless the armament system circuit breakers are on and the MASTER ARM switch is in either STBY or ARM TEST SWITCH. The TEST position illuminates the entire caution light system. Testing the system will not change any malfunction indication existing prior to testing. There is no provision for the copilot to reset his MASTER CAUTION light.

Fire Warning System.

Fire warning lights are located in the FIRE 1 PULL and FIRE 2 PULL handles on the pilot instrument panel (figure 1-24). Two lights are located in the copilot/gunner glare shield and indicate FIRE ENG 1 and FIRE ENG 2 when illuminated. The pilot and copilot/gunner lights are connected in parallel and both sets of lights illuminate when energized. A FIRE WARN TEST switch is located on the pilot instrument panel. The switch is spring-loaded to the off position. The TEST position causes all four fire warning lights to illuminate aviation red, indicating the system is operational. Excessive heat in engine 1

compartment causes FIRE 1 PULL and FIRE ENG 1 lights to illuminate. Excessive heat in engine 2 compartment causes FIRE 2 PULL and FIRE ENG 2 lights to illuminate. Power is supplied by the 28 vdc essential bus and protected by ENG NO. 1 FIRE DET and ENG NO. 2 FIRE DET circuit breakers.

CAUTION

Do not actuate the FIRE WARN TEST switch more than 15 seconds. Prolonged use will overheat the detector elements.

FIRE EXTINGUISHER SYSTEM OPERATION.

Illumination of either fire warning light indicates excessive heat in the respective engine compartment (figure 1-25). Pulling the FIRE PULL handle will shut off fuel to the affected engine, deactivate the ECU and rain removal circuits, close the particle separator door, and arm both fire extinguisher bottles. Positioning the FIRE EXT switch to either MAIN or RESERVE will discharge selected bottle into the affected engine compartment (Figure 1-25). To use the remaining bottle, move the FIRE EXT switch to the opposite position. Fire light illumination is not required to discharge the extinguishers. Power is supplied by the 28 vdc essential bus and protected by two circuit breakers marked FIRE EXT MAIN and FIRE EXT RSV.

NOTE

Pulling a FIRE PULL handle and positioning the FIRE EXT switch to MAIN will result in that bottle being discharged into the selected engine compartment. If both FIRE PULL handles are pulled out and the FIRE EXT switch is moved to MAIN position, the bottle will not discharge. If the switch is moved to the RESERVE position, only one bottle will discharge. The discharged extinguishing agent will be routed to both engine areas and could be ineffective in either engine area.

Fire Extinguisher.

A portable fire extinguisher is located on the bulkhead to the left of the copilot/gunner seat.

First Aid Kit.

An aeronautical type first aid kit is located on the aft bulkhead of the pilot compartment.

Survival Kit.

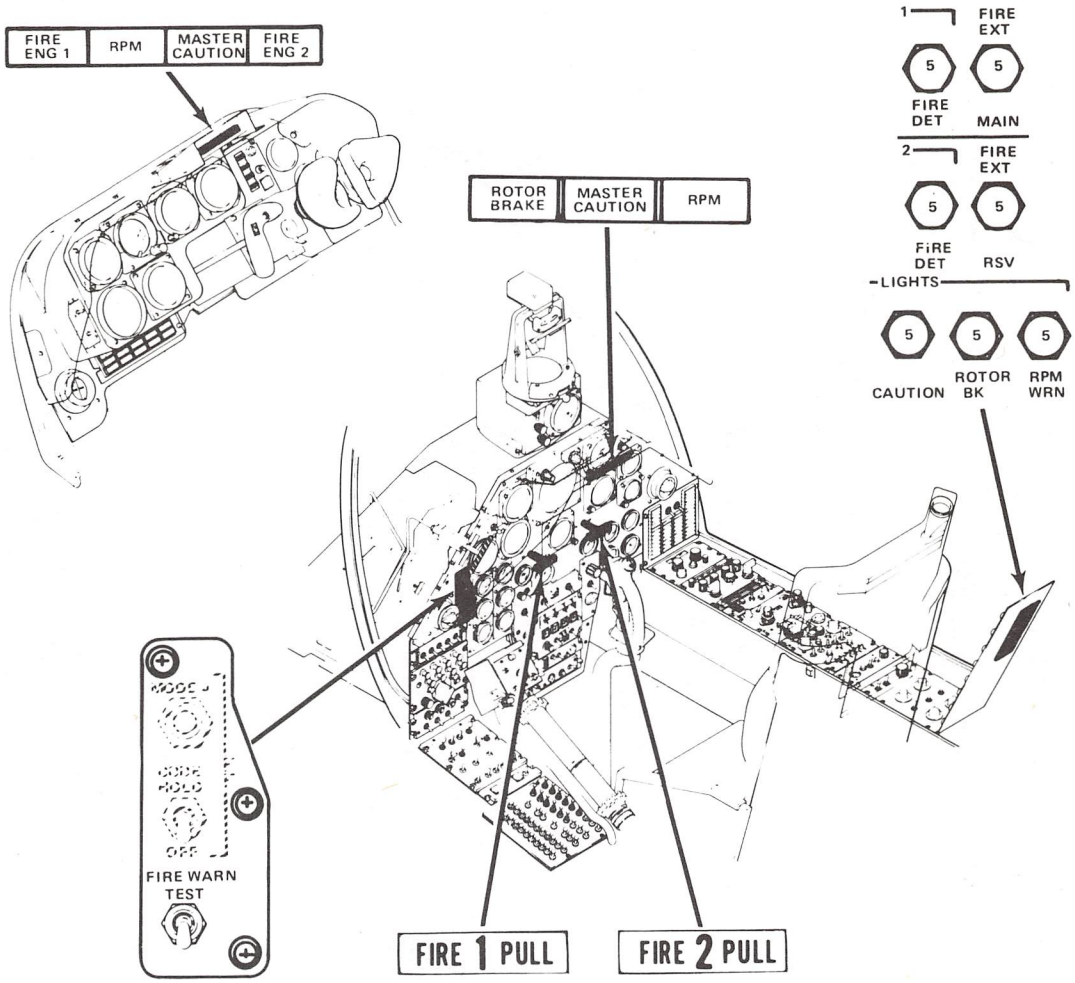
(Space Provisions only)

CREW COMPARTMENT DOORS.

Pilot and copilot/gunner access is provided by canopy doors that are hinged at the top and swing outward and up. The pilot canopy door opening is on the right side and the copilot/gunner canopy door is on the left side. Both doors are opened or closed either electrically or manually from inside or outside. Both doors may be stopped electrically in any position between open and one inch from closed. Both doors have switches located near the door handles for electrical operation (figure 1-26). To open either door manually from the closed position, turn door handle and raise door to desired position and trip (up) manual clutch release (figure 1-26). To close either door manually or to open door from a position other than closed, depress (down) manual clutch release and move the door. Clutch may be engaged manually or electrically. Key locks are provided in each door handle.

CANOPY JETTISON SYSTEM.

A canopy jettison system provides for rapid crew egress in emergency situations (figure 1-26). The system consists of a linear explosive system, used to cut the side windows from the canopy support structure, three canopy jettison handles, and the interconnecting lines of flexible confined detonating cord. ARM/FIRE mechanisms are manually activated percussion type detonators. When fired, all four window cutting assemblies will be immediately detonated to blow the four side windows outward in fragments, leaving empty frames for exit or access. Jettison handles are located on the pilot instrument glareshield, copilot/gunner right console, and in the nose for rescue crew. The system can be actuated by any one of the three handles. The canopy jettison handles have safety pins to prevent accidental firing of the system. The pins must be pulled before the system can be actuated. To actuate the system, rotate any handle 90 degrees counterclockwise and pull. Stowage for safety pins is provided.

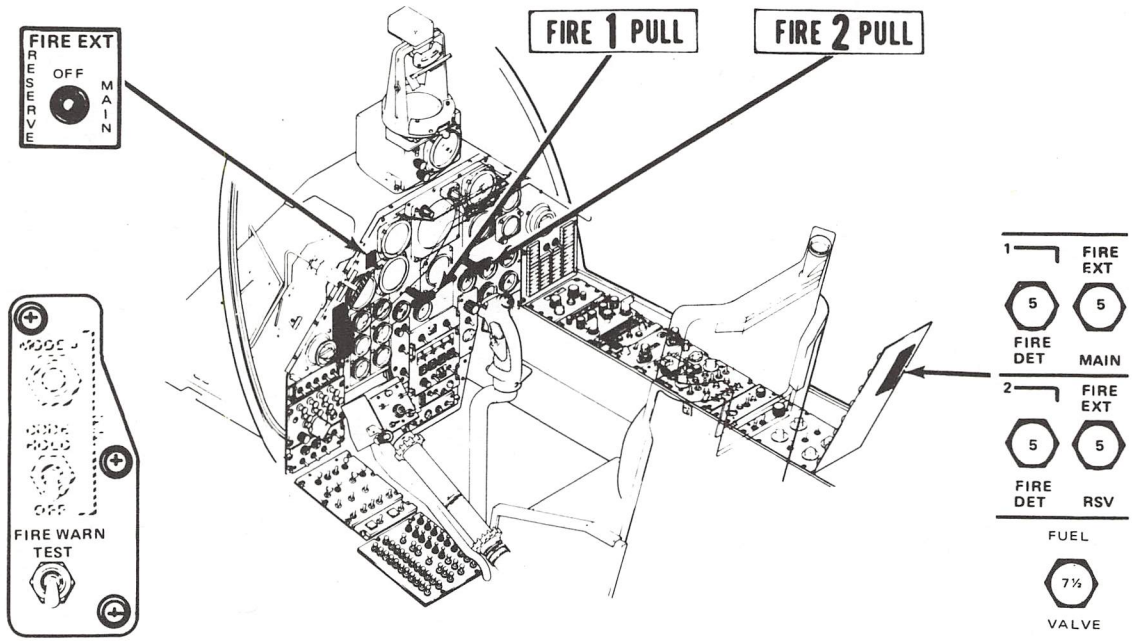


NOMENCLATURE	FUNCTION
ROTOR BRAKE	Illuminate when rotor brake is pressurized.
*MASTER CAUTION	Illuminate to alert crew to check caution panel.
*RPM	Illuminate when rotor rpm is high or low or when gas producer is low.
*FIRE 1-2	Illuminate to show fire in respective engine compartment.
Circuit breakers	Protect respective electrical circuit.
FIRE WARN TEST switch	Test fire warning lights.

*Repeater lights on copilot/gunner instrument panel.

210900-120

Figure 1-24. Warning/Caution Lights

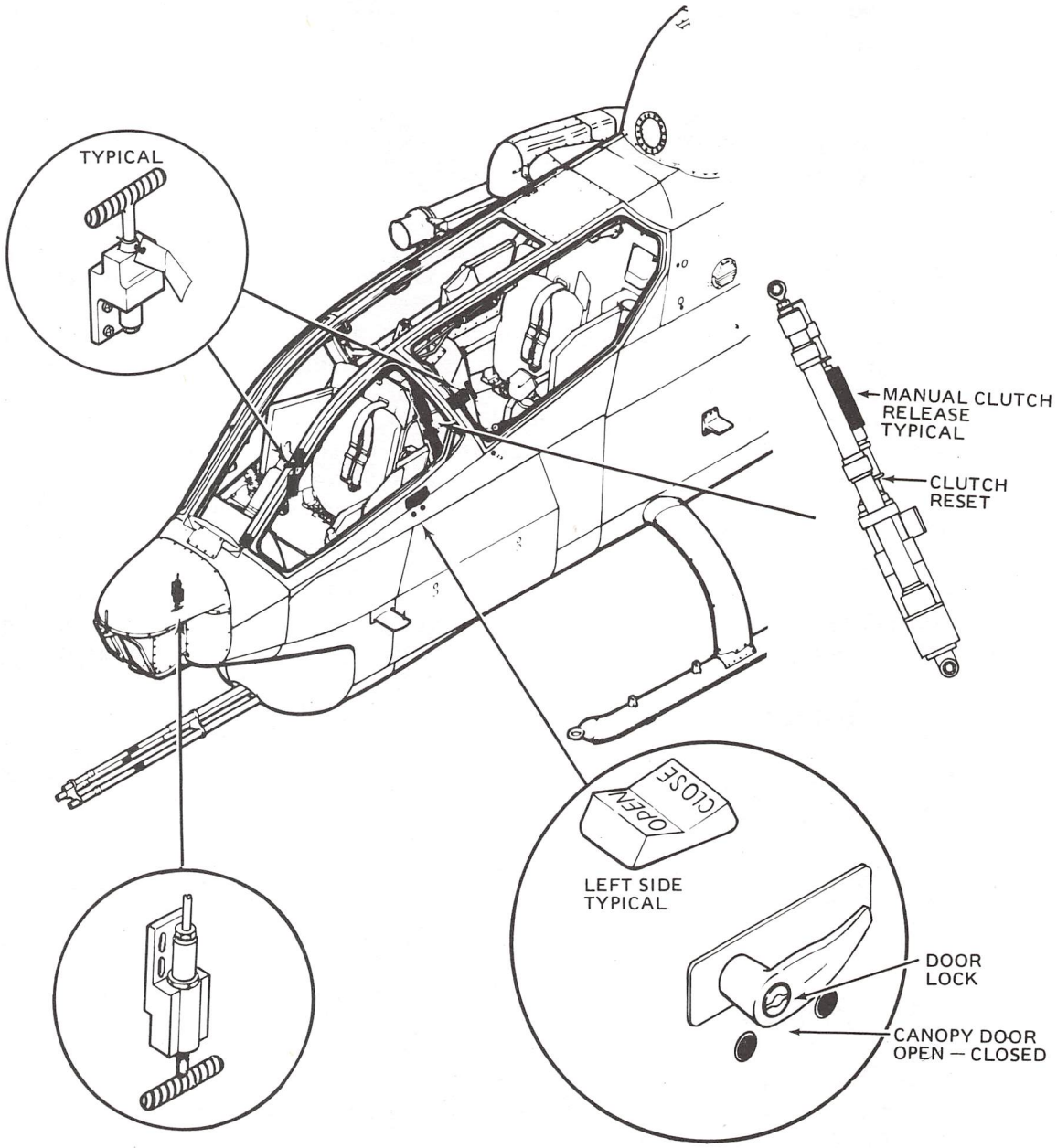


NOMENCLATURE	FUNCTION
FIRE EXT switch	MAIN — Fires main fire bottle.
	OFF — Deactivates fire bottles.
	RESERVE — Fires reserve fire bottle.
FIRE 1/2 PULL handle	Illuminate to show fire in respective engine
	When pulled;
	Shut off fuel to respective engine.
	Deactivate ECU and rain removal circuits.
	Close particle separator door.
	Arm both fire extinguisher bottles.
Circuit breakers	Protect electrical circuits
FIRE WARN TEST switch	Test fire warning lights.

NEW NEW NEW

210900-119

Figure 1-25. Fire Extinguishing System



NOMENCLATURE	FUNCTION
CANOPY JETTISON HANDLE	Removes glass from doors and windows.
DOOR ACTUATOR	Position door.
DOOR HANDLE	Locks door in closed position and deactivates electrical circuit.
DOOR SWITCHES	Opens or closes door electrically.
DOOR LOCK	Secure helicopter doors.

210900-118

Figure 1-26. Entrance/Egress Systems

NEW NEW

WARNING

Helmet visors shall be down prior to activation of the CRS to preclude possible eye injury.

PILOT SEAT.

The pilot seat is a vertically adjustable, nonreclining type, installed at a reclined angle of 15 degrees (figure 1-3). The vertical height adjustment is on the left side of the seat. The back, bottom and side panels are made of ceramic and fiberglass composite armor.

Additional protection is provided by side shoulder panels which can be installed on or removed from the basic seat. The seat is equipped with seat and back cushions. A lap safety belt and inertia-reel shoulder harness is also installed.

COPILOT/GUNNER SEAT.

The copilot/gunner seat is a fixed seat, installed at a reclined angle of 15 degrees (figure 1-4). The seat is made of ceramic and fiberglass composite armor. The seat is equipped with a lap belt, inertia-reel shoulder harness, plus seat and back cushions. Arm rests are provided for each side of the seat.

SHOULDER HARNESS.

An inertia-reel and shoulder harness is installed on the pilot and copilot/gunner seats with a manual lock-unlock control handle. With the control in the unlocked position, the reel cable will extend to allow the occupant to lean forward. However, the reel will automatically lock when the helicopter encounters an impact force in excess of two G deceleration. Locking of the reel can be accomplished with the harness at any position, and the reel will automatically take up the slack in the harness. To release the lock it is necessary to lean back slightly to release tension on the lock and move the control handle to the lock and then unlock position. It is possible to have pressure against the seat whereby no additional movement can be accomplished and the lock cannot be released. If this condition occurs, it will be necessary to loosen shoulder harness. The reel should be manually locked for takeoff and landing.

VENTILATING SYSTEM.

Ventilating air is supplied through the air inlet located on the leading edge of the pylon fairing. Outside air is routed through an electrical blower into the distribution system (figure 1-27). The ECU/VENT switch is mounted on the pilot instrument panel (figure 1-28). Placing the ECU/VENT switch to VENT, actuates the system. The pilot has adjustable outlets on his instrument panel and controllable outlets on each side of the instrument panel. The outlets on the instrument panels shroud provide air for defogging the canopy area. Controllable ventilating air is also routed through the pilot seat and back cushion. The copilot/gunner has one instrument panel mounted adjustable outlet. Ventilating air is also routed through the copilot/gunner seat and back cushion. Air volume through the instrument panel outlet is regulated by the butterfly in the outlet. Power is supplied by the 28 vdc essential bus and protected by the VENT BLO circuit breaker.

Ventilating System Operation.

The ventilation system serves as a backup to the copilot/gunner air conditioning system. This system provides crew ventilation through two pilot outlets, and two copilot/gunner outlets.

Defrosting/Defogging.

The ECU provides heated air for defrosting. Heated air is directed to the side areas of the canopy.

Rain and Ice Removal System.

Removal of rain or ice from the forward window panel is accomplished by placing RAIN RMV switch to RAIN RMV (figure 1-29). The switch is located in the ECU panel on the pilot right console. When the RAIN RMV switch is actuated, bleed air valves open and bleed air mixed with outside air is directed to the base of the forward windshield.

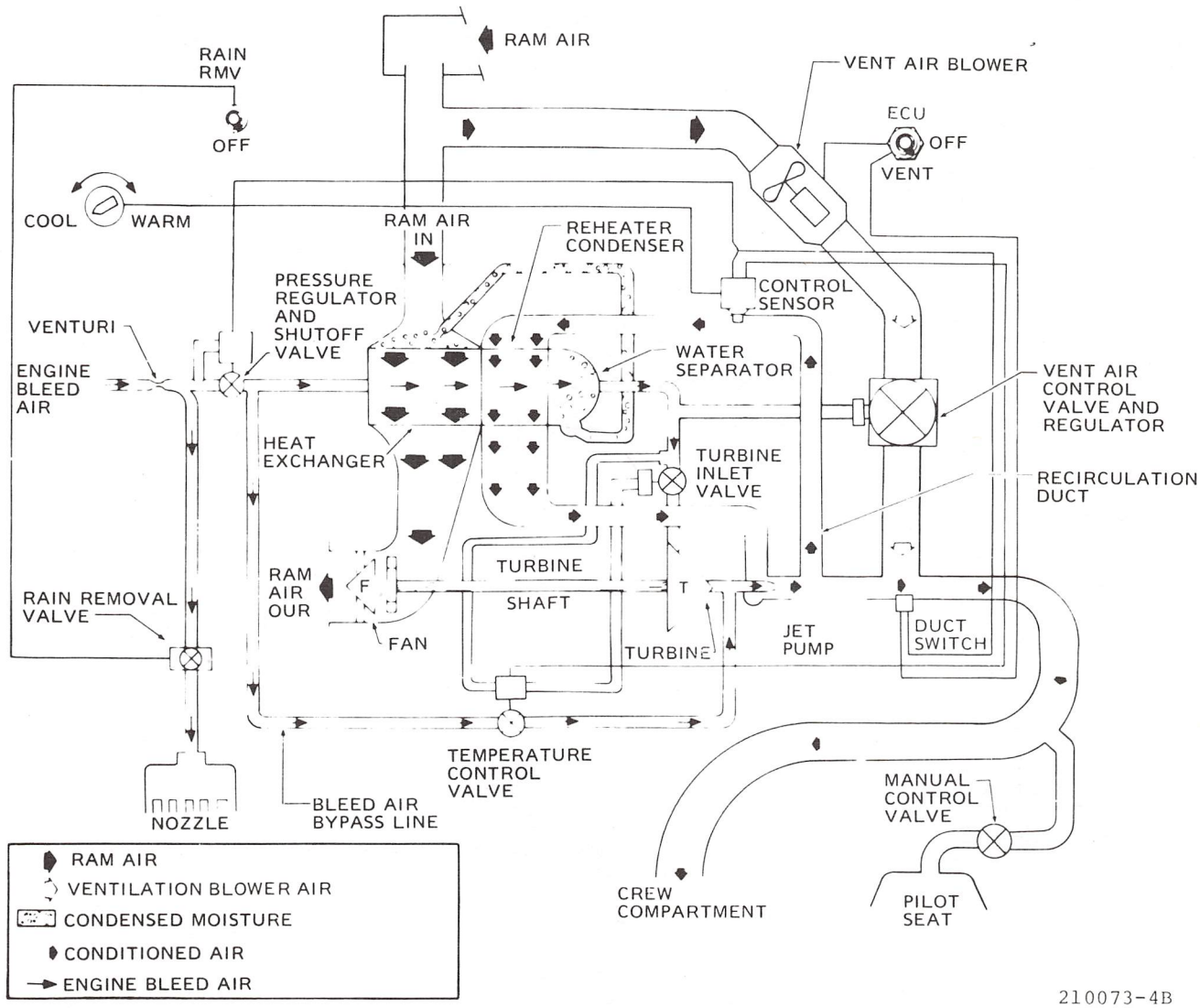
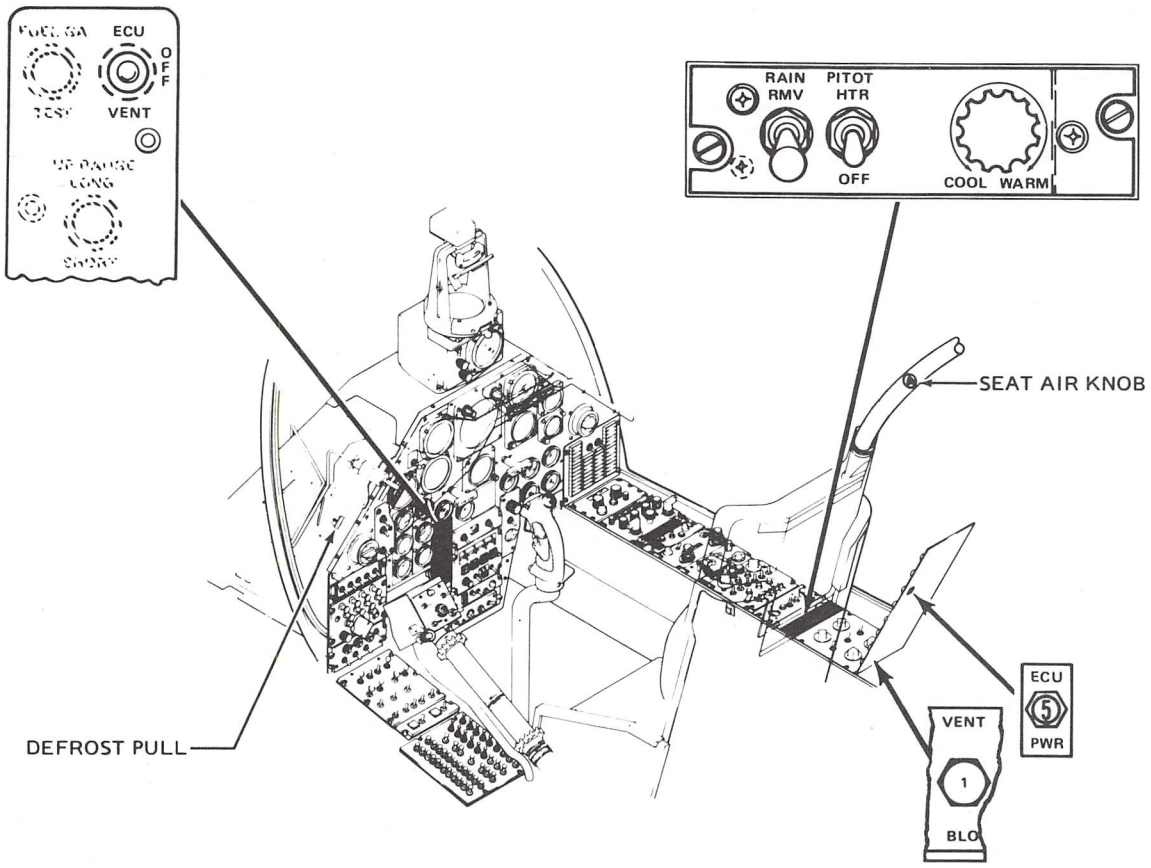


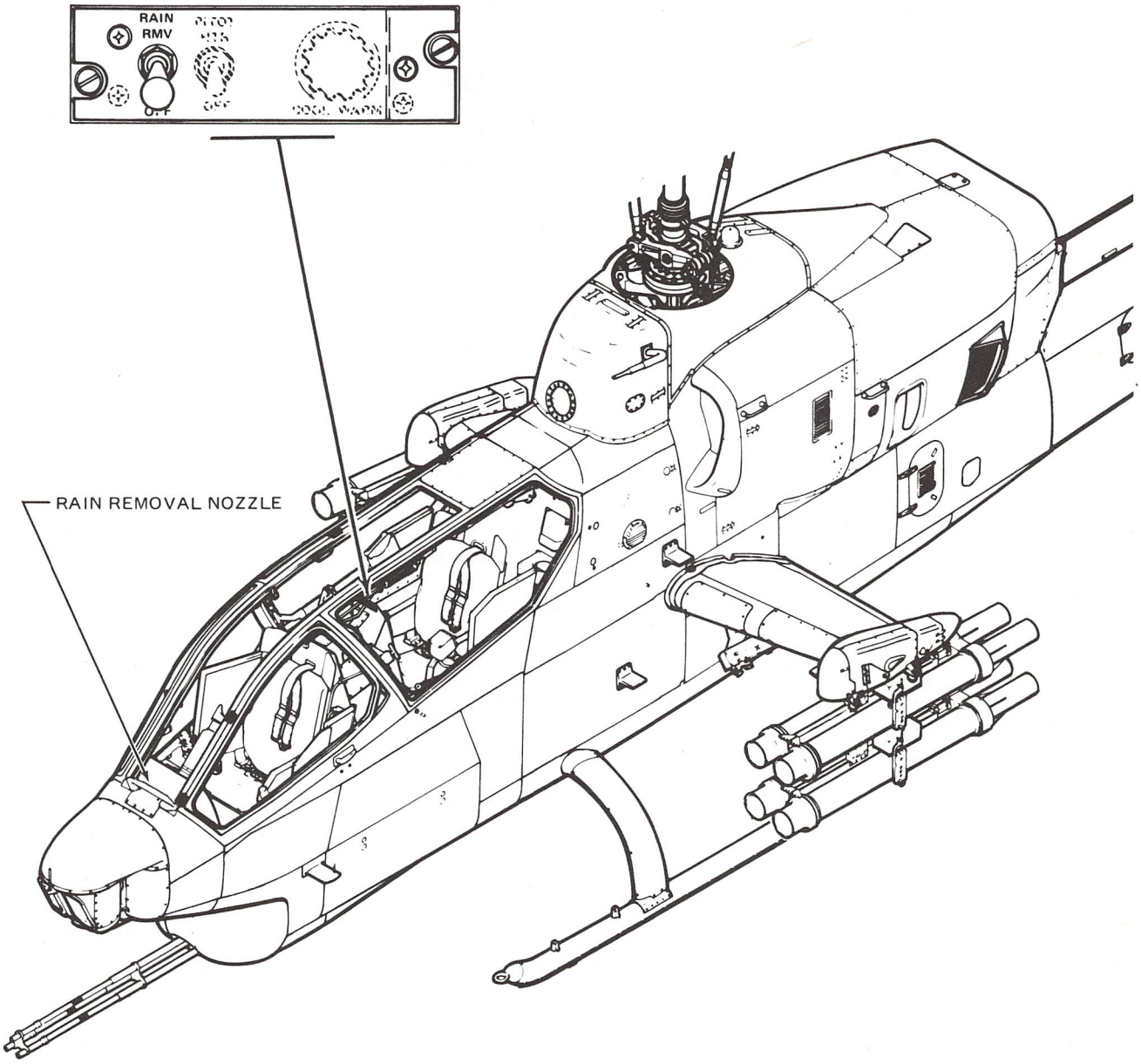
Figure 1-27. Environmental Control System Schematic



NOMENCLATURE	FUNCTION
ECU/OFF/VENT switch	ECU — supply conditioned air to the crew compartment. OFF — deactivate system. VENT — supply ambient air to the crew compartment.
COOL WARM knob	Adjust temperature of conditioned air.
Seat air knob	Adjust volume of air to the respective seat.
Circuit breaker	Protect electrical circuit.
DEFROST PULL	Adjust volume of air to the canopy.

210900-131

Figure 1-28. Environmental Control System



NOMENCLATURE	FUNCTION
RAIN RMV/OFF switch	RAIN RMV — supply bleed air to the rain removal nozzle OFF — remove power from system
Rain removal nozzle	Distribute air over windshield.

210900-130

Figure 1-29. Rain Removal System

Environmental Control Unit (ECU)

The ECU is located in the hydraulic compartment. Conditioned air from the ECU is supplied through the air distribution system. The ECU/VENT switch, in the ECU position, actuates the unit. The COOL/WARM knob regulates the temperature of the outlet air. The COOL/WARM knob is located on the control panel in the pilot right console. Power is supplied by the 28 vdc essential bus and protected by the ECU PWR circuit breaker (figure 1-29. The rain RMV and ECU switches should be in the OFF or VENT position during flight conditions requiring maximum engine performance due to reduction in engine power available.

NEW NEW NEW

Power is supplied by the 28 vdc essential bus and protected by the ECU PWR circuit breaker (figure 1-28).

EXTERIOR LIGHTS.

Navigation Lights.

The navigation lights are controlled from the LIGHTS control panel. Two switches are provided for control of the navigation lights, FLASH-OFF-STEADY and BRT-DIM. Power is supplied by the 28 vdc essential bus and protected by the NAV LIGHTS circuit breaker.

Anti-collision Light.

The anti-collision light is mounted on top of the engine cowl (figure 1-30). The light is controlled by a switch in the LIGHTS control panel. The switch is a two-position switch marked ANTI-COLL LT ON-OFF. Electrical power for the light is supplied from the 28 vdc essential bus and protected by the ANTICOLLISION LIGHTS circuit breaker.

Fuselage Formation Lights.

The fuselage formation lights consist of five green lights (figure 1-30). One is located on top of the 90 degree gearbox, two on top of the pylon fairing, and one on the top surface of each wing tip. The lights are controlled from the LIGHTS control panel. A FUSELAGE switch is provided for turning the formation lights on and varying the brightness from off to bright. Power is supplied by the 115 vac nonessential bus and protected by the FORM LT PWR and FUS circuit breaker.

Rotor Tip Formation Lights.

The rotor tip formation lights are two white lights, one installed on each rotor tip (figure 1-30). The lights are controlled from the LIGHTS control panel. A ROTOR TIP switch is provided for turning the lights on and varying the brightness from OFF to BRT. Power is supplied by the 115 vac nonessential bus and protected by the ROTOR FORM LT circuit breaker.

Searchlight.

The controllable searchlight is located in the bottom fuselage section beneath the copilot/gunner station. Control switches are provided for both pilot and copilot/gunner. The pilot control switches are located in the collective stick switch box (figure 1-31). The switches are marked SRCH LT - EXT/RET/L/R and SRCH LT ON/OFF/STOW.

The copilot/gunner switches are located in the miscellaneous panel. The switches are marked SRCH LT, ON-OFF AND EXT-RETR. The pilot has the capability to rotate the light right or left, the copilot/gunner does not have this capability. Power is supplied by the 28 vdc essential bus and protected by the SRCH PWR and SRCH CONT LIGHTS circuit breakers.

INTERIOR LIGHTS.

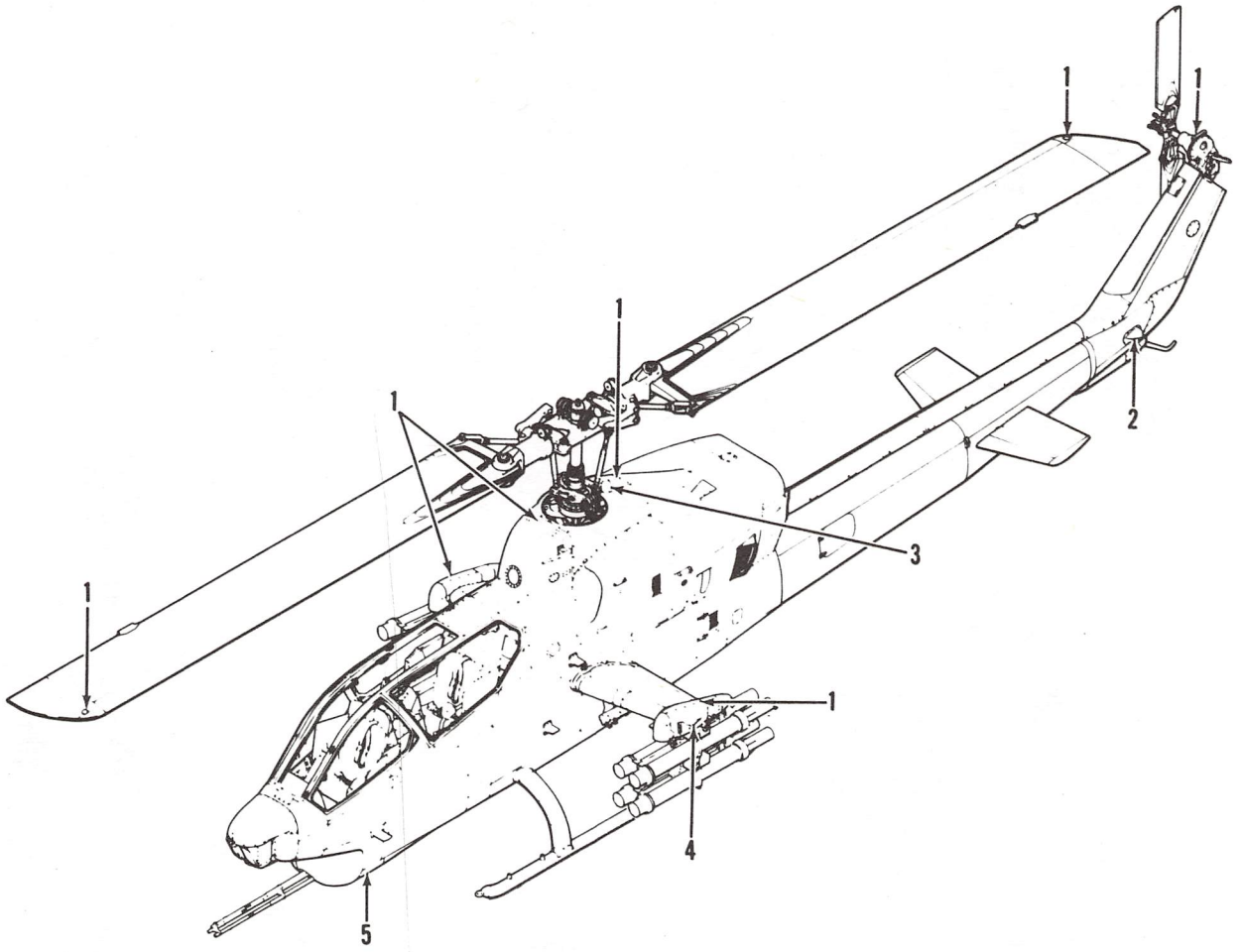
Crew Compartment Lights.

The pilot and copilot/gunner cockpit lights are located on the side armored seat panels (figure 1-31). Rheostat operating switches for the lights are mounted on the light assembly body. Brightness is controlled by operation of the rheostat. Rotation of the lens clockwise provides white lighting, counterclockwise red lighting. The rheostat is also the ON-OFF switch for the light assembly. Power is supplied by the 28 vdc essential bus and protected by the CKPT LIGHTS circuit breaker.

Pilot, Copilot/Gunner Instrument Lights.

The pilot, co-pilot/gunner instruments contain internal lighting. A pilot rheostat marked INST LTS is located on the LIGHTS panel (figure 1-31). A copilot/gunner rheostat marked INST LT is located on the miscellaneous control panel. Power is supplied by three 5 vdc instrument lighting power supplies. One for the copilot and two for the pilot; these are in turn powered by the 28

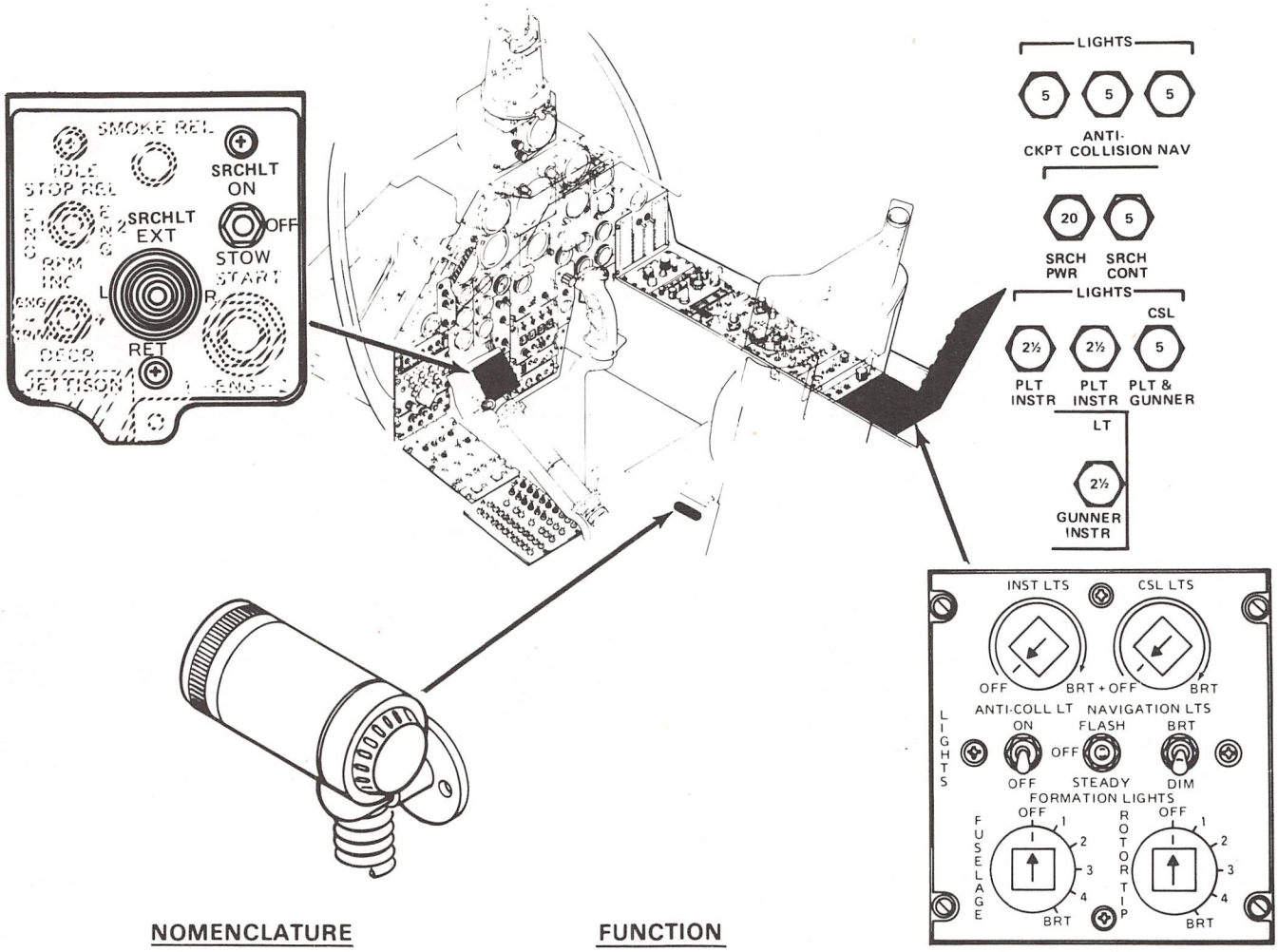
NEW



210900-129

1. FORMATION LIGHTS
2. AFT NAVIGATION LIGHT (RH NOT SHOWN)
3. ANTICOLLISION LIGHT
4. LEFT NAVIGATION LIGHT (RH NOT SHOWN)
5. SEARCHLIGHT (NOT SHOWN)

Figure 1-30. Exterior Lighting



NOMENCLATURE	FUNCTION
SRCH LT switch	ON — activates search light.
	OFF — deactivates search light.
	STOW — stows search light.
SRCH LT spring switch	EXT — extends search light to vertical position.
	R — turns light to the right.
	L — turns light to the left.
	RET — retracts light to horizontal position.
Circuit breakers	Protects electrical circuit.
INST LTS knob	OFF — deactivates lights.
	BRT — adjusts light to full intensity.

210900-128

Figure 1-31. Interior Lights (Sheet 1 of 2)

NOMENCLATURE	FUNCTION
CSL LTS	OFF — deactivates lights.
	BRT — adjusts light to full intensity.
ANTI-COLL LT	ON — activates light.
	OFF — deactivates light.
NAVIGATION LTS switches FLASH/OFF/STEADY	FLASH — activates lights flashing cycle.
	OFF — deactivates lights.
	STEADY — activates lights.
BRT/DIM	Controls brilliance.
FORMATION LIGHTS knobs FUSELAGE	OFF — deactivates lights.
	1 to BRT — controls brilliance.
ROTOR TIP	OFF — deactivates lights
	1 to BRT — controls brilliance.
MAP LIGHT	Provides pilot with moveable lighting.
NOTE	
Copilot/gunner compartment not shown.	
INSTR LT knob	OFF — deactivates light.
	BRT — adjusts light to full intensity.
CSL LT knob	OFF — deactivates light.
	BRT — adjusts light to full intensity.
SRCH LT switches ON/OFF	ON — activates light.
	OFF — deactivates light.
EXT/RET	EXT — extends search light to vertical position.
	RETR — retracts light to horizontal position.
Map Light	Provides copilot/gunner with movable lighting.

210900-9-2A

Figure 1-31. Interior Lights (Sheet 2 of 2)

NEW vdc essential bus. Circuit protection is provided by the PLT INST LTS and GUNNER INSTR LT circuit breakers.

Pilot, Copilot/Gunner Console Lights.

The pilot, copilot/gunner consoles contain internal lighting. A rheostat marked CSL LTS is located on the pilot LIGHTS panel (figure 1-31), and copilot/gunner miscellaneous control panel.

Power is supplied by the 28 vdc essential bus and protected by the CSL PLT and GUNNER LIGHTS circuit breaker. NEW

PART 3 — SERVICE AND HANDLING

FUELING AND SERVICING.

Servicing points are presented on the Servicing Diagram (figure 1-32). See figure 1-33 for specifications. See figure 1-34 for system capacities. See figure 1-35 for turning radius and ground clearance, figure 1-36 for rotor blade danger area.

Crew and Truck.

Only authorized and qualified personnel shall operate fueling equipment. The plane captain shall be responsible for fueling the helicopter after each flight. He will make a visual check to ensure the proper fuel is used. Do not locate the helicopter in the vicinity of possible sources of ignition, such as blasting, drilling or welding operations. A minimum of 50 feet should be maintained from other aircraft and 75 feet from any operating radar set. Aircraft servicing vehicles will be positioned parallel to the helicopter during any servicing operation.

Grounding.

Prior to fueling, grounding devices on helicopter and on trucks shall be inspected by fueling personnel for proper ground.

Electrical Hazard.

Turn off all switches and electrical equipment in helicopter. Check that no electrical apparatus, supplied by outside power (electrical cords, drop lights, floodlights, etc.) is in or near the helicopter. For night fueling, safety flashlights shall be used.

Static Differential.

Before using a fuel hose, the hose nozzle shall be brought in contact with some metal part of the helicopter, remote from the fuel cells to eliminate any static differential that exists. This procedure should result in eliminating static differential to reduce the chance of static spark at fuel cell filler port.

Attaching Wire Clamp.

Before removing the cell filler caps, the hose nozzle ground attachment shall be connected to a metal part of the helicopter at a safe distance from filler openings and cell vents.

Fire Extinguishers and Attendant.

During fueling, a secondary operator or assistant plane captain will man a CO2 hand extinguisher with a second extinguisher readily available.

ENGINE WASH PROCEDURES.

There are two types of engine wash procedures; the engine performance recovery wash and the engine desalinization rinse.

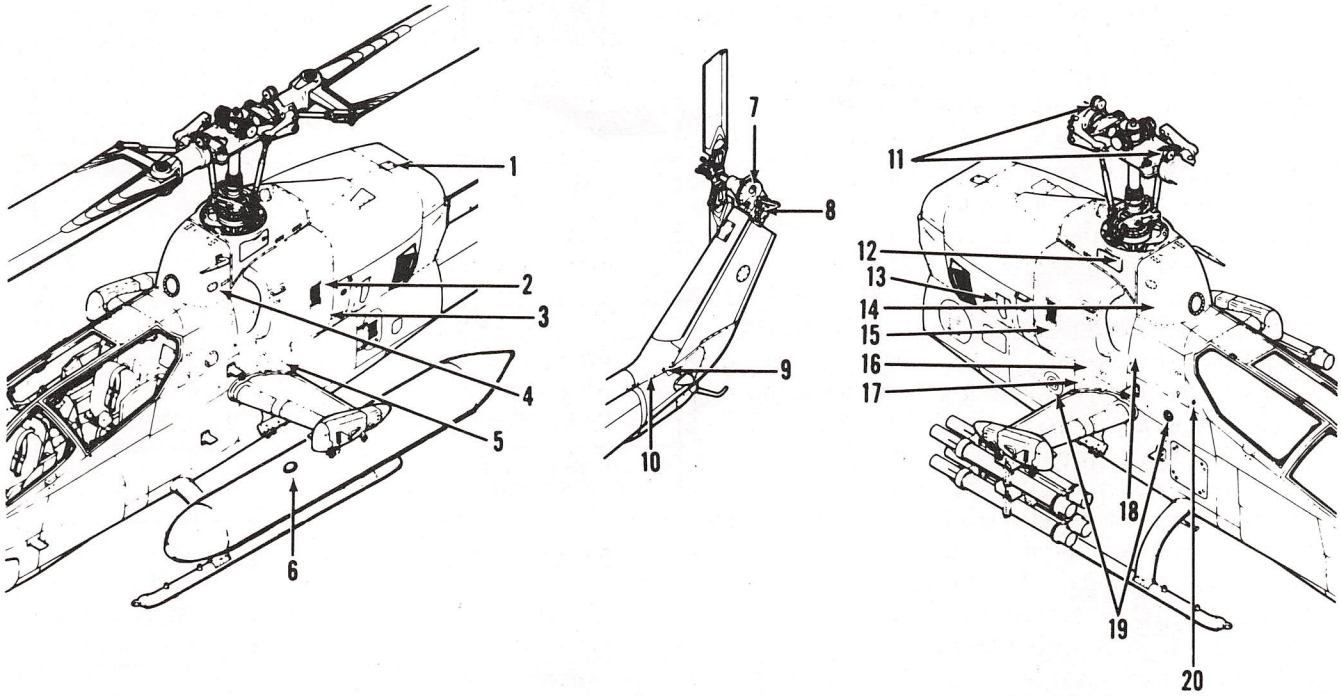
Only personnel designated in writing by commanding officers shall be authorized to conduct engine motoring wash procedures.

Engine Performance Recovery Wash

An engine performance recovery wash shall be required when a deterioration in engine performance is noted and/or the helicopter has hovered below 30 feet over salt water.

Prior to the wash, the engine shall be allowed to cool for a minimum of 40 minutes.

1. Armament — OFF/SAFE
2. FUEL — OFF



210900-127

1. COMBINING GEARBOX OIL FILLER
2. ENGINE OIL FILLER INSIDE COWLING
3. ENGINE OIL SIGHT GAGE WINDOW
4. NO. 1 HYDRAULIC SIGHT GAGE WINDOW
5. ENGINE OIL SIGHT GAGE LIGHT SWITCH
6. WING TANK FILLER — SAME ON RIGHT SIDE
7. TAIL ROTOR GEARBOX FILLER
8. TAIL ROTOR GEARBOX SIGHT GAGE
9. INTERMEDIATE GEARBOX SIGHT GAGE
10. INTERMEDIATE GEARBOX FILLER INSIDE COWLING
11. ROTOR HUB RESERVOIRS
12. TRANSMISSION FILLER CAP
13. COMBINING GEARBOX SIGHT GAGE
14. NO. 1 HYDRAULIC FILTER WINDOW
15. ENGINE OIL FILLER INSIDE COWLING
16. TRANSMISSION SIGHT GAGE
17. ENGINE AND XMSN SIGHT GAGE LIGHT SWITCH
18. NO. 2 HYDRAULIC SIGHT GAGE AND FILTER
19. FUEL FILLER
20. GROUNDING RECEPTACLE

Figure 1-32. Servicing Diagram

SYSTEM	SPECIFICATION			
	STANDARD	ALTERNATE	EMERGENCY	
FUEL	JP-5 JP-4	JP-8(MIL-T-83133) ASTMD-1655 JETA/JetA-1		
OIL				
ENGINE SECTIONS	SHELL ASTRO 555*			
COMBINING GEARBOX	SHELL ASTRO 555*			
TRANSMISSION	SHELL ASTRO 555*			
INTERMEDIATE GEARBOX	SHELL ASTRO 555*			
TAIL ROTOR GEARBOX	SHELL ASTRO 555*			
MAIN ROTOR HUB GRIPS	MIL-L-46152	ANY HIGH DETERGENT 10 W 30 OIL		
HYDRAULIC SYSTEMS				
NO. 1 and NO. 2	MIL-H-83282	MIL-H-5606	NONE	

NEW NEW NEW

*Preheating required for temperatures below -40°C.

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*NATO SYMBOL	U.S. MILITARY SPEC MIL-J-5624 GRADES	U.S. COMMERCIAL SPEC ASTM D-1655-62T GRADES	U.K. GRADES
F-44	***JP-5	None	AVCAT/48
F-40	JP-4	**JET B	AVTAG
F-34	None	JET A-1	AVTUR/50
None	None	****JET A	None

* The NATO symbols denote general types of fuels as manufactured under several national military and commercial specifications, and can be applied to products meeting a general category. Fuels having the same NATO symbol are interchangeable for use by military aircraft.

** Equivalent to JP-4 except that freezing point is -60°F vice -76°F.

*** F-44 approved fuel afloat — F-44 and F-40 approved fuel ashore.

**** Equivalent to JET A-1 except freezing point is -38°C vice -50°C.

Figure 1-33. Specification Sheet

SYSTEM	CAPACITIES		
	AVAILABLE	UNUSABLE	
FUEL			
FORWARD FUEL CELL	190 US GAL		
AFT FUEL CELL	123 US GAL		
	313 US GAL	2 US GAL	
RIGHT WING TANK	100 US GAL	0.42 US GAL	
LEFT WING TANK	100 US GAL	1.15 US GAL	
	513 US GAL	3.57 US GAL	
OIL			TOTAL
ENGINE SECTION 1	3 US QUARTS	3.4 QUARTS	6.4 QUARTS
ENGINE SECTION 2	3 US QUARTS	3.4 QUARTS	6.4 QUARTS
COMBINING GEARBOX	1 US QUART	4 QUARTS	5 QUARTS
TRANSMISSION	15-1/2 QTS	0*	18-1/2 QUARTS
INTERMEDIATE GEARBOX	3-1/2 PINTS		3-1/2 PINTS
TAIL ROTOR GEARBOX	4-1/2 PINTS		4-1/2 PINTS
MAIN ROTOR HUB GRIP No. 1	2 US QUARTS		2 QUARTS
MAIN ROTOR HUB GRIP No. 2	2 US QUARTS		2 QUARTS
HYDRAULIC			
SYSTEM No. 1	9 PINTS		
SYSTEM No. 2	11 PINTS		
*TRANSMISSION OIL COOLER CIRCUIT CONTAINS AN ADDITIONAL 3 QUARTS WHICH IS TO BE CONSIDERED UNUSABLE.			

Figure 1-34. System Capacities

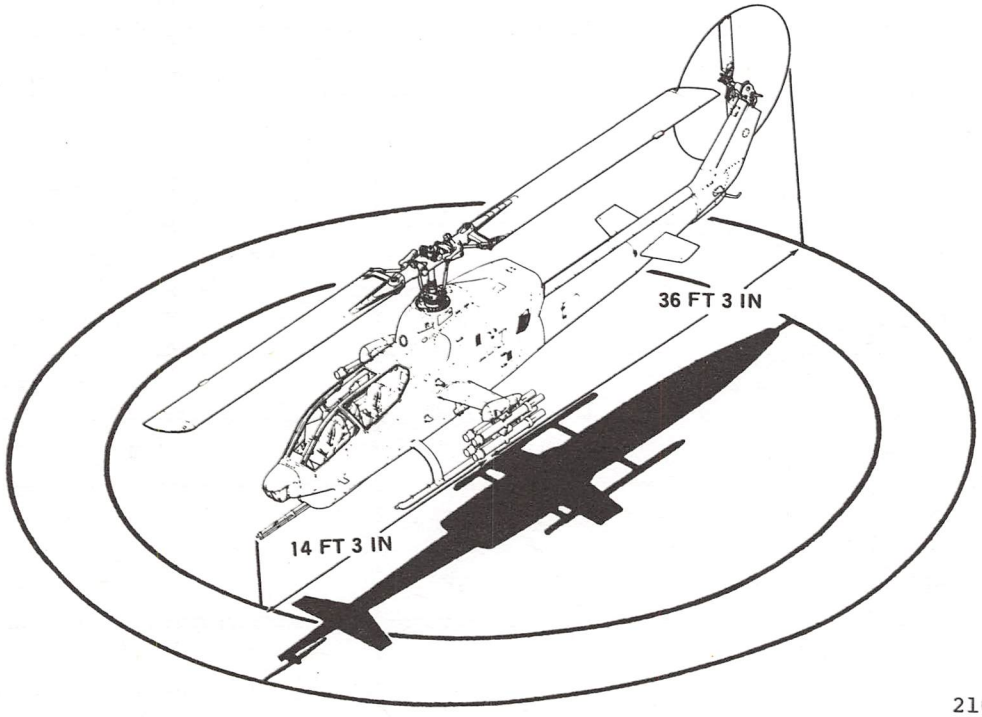
NOTE

MINIMUM GROUND CLEARANCES

Main Rotor Blades Stationary	–	9 FT. 0 IN.
Tail Skid	–	2 FT. 10.3 IN.
Tail Rotor Blades Stationary	–	4 FT. 6 IN.
Bottom of Fuselage	–	1 FT. 8.4 IN.*
Bottom of Turret	–	1 FT. 3 IN.

*CHECK ANTENNAS THAT MAY PROTRUDE LOWER

NEW



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Figure 1-35. Turning Radius on Ground Handling Wheels

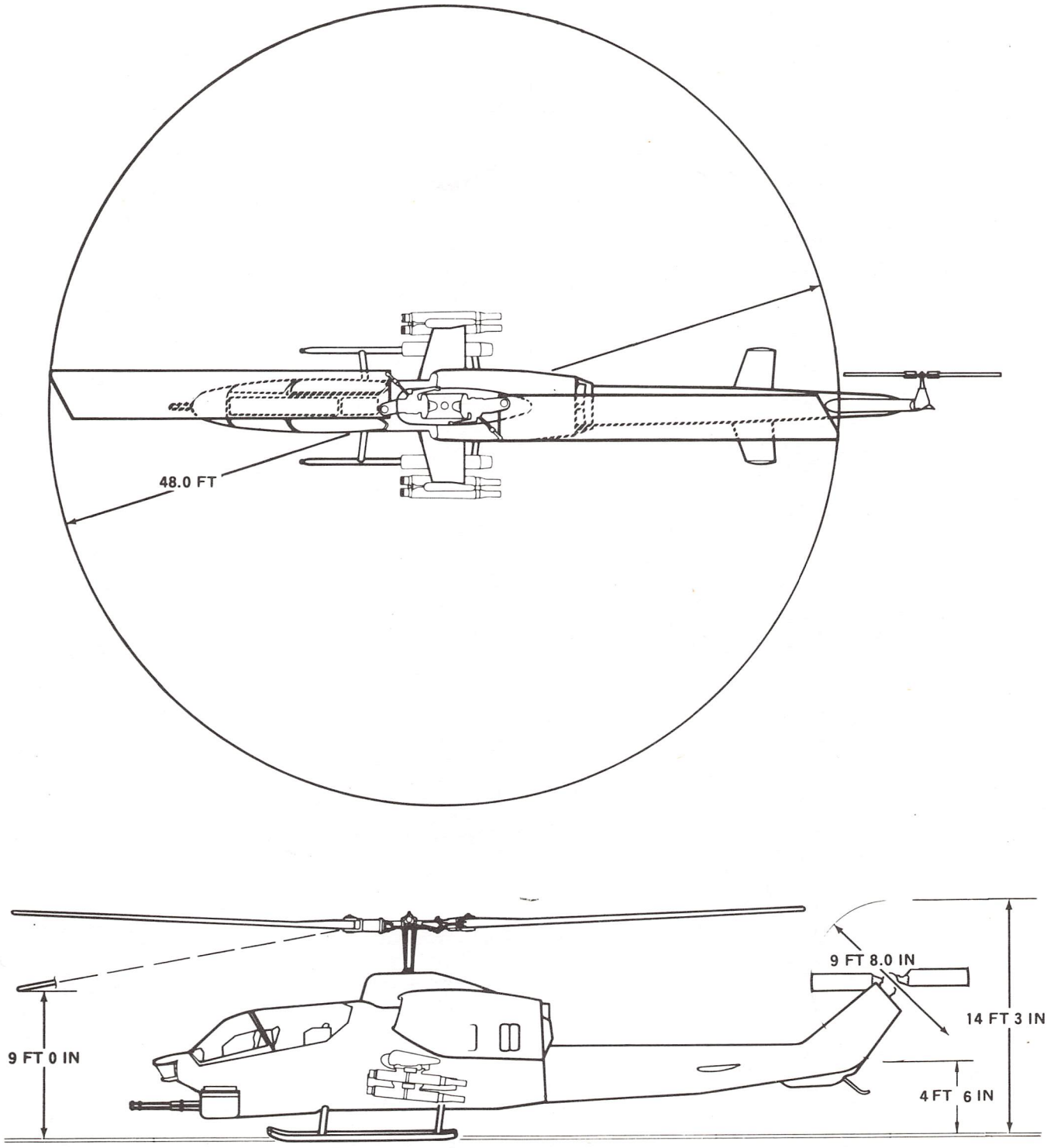


Figure 1-36. Rotor Blade Danger Area (Sheet 1 of 2)

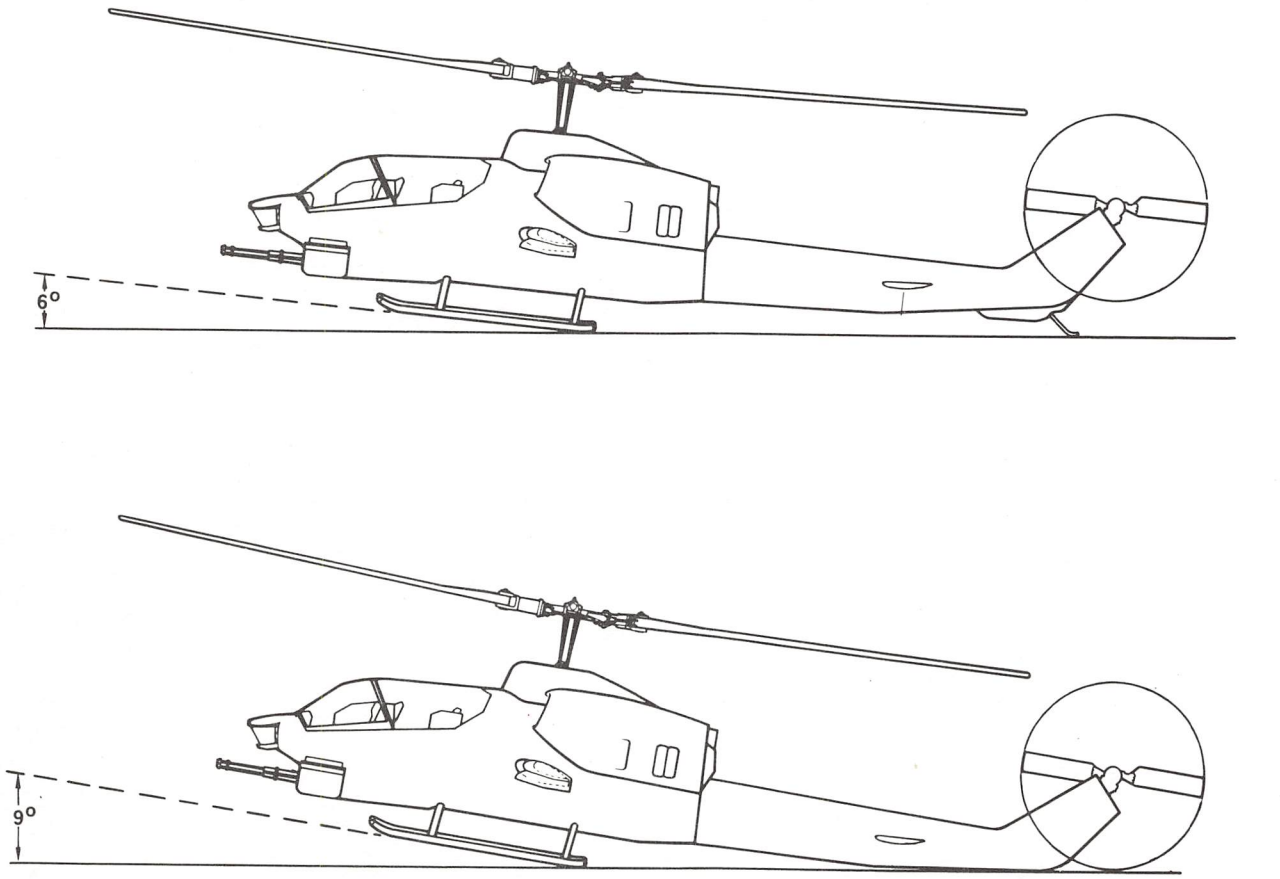


Figure 1-36. Rotor Blade Danger Area (Sheet 2 of 2)

3. BATTERY — ON
4. APU — CONNECTED (If available)
5. Throttles — OFF
6. START switch — ON (for engine being washed) 30 second limit.
7. START switch — OFF (one minute off)
8. Repeat steps 6 and 7 for second engine.

Allow the cleaning solution to soak for a minumum of 10 minutes and maximum of 30 minutes, then rinse twice with fresh water utilizing steps 6 and 7.

The following dry cycle is optional except for cases where antifreeze has been added to fluids:

1. START switch — ON (for engine being dried) 30 second limit.
2. START switch — OFF.
3. Repeat steps 1 and 2 for second engine.

Engine Desalinization Rinse

An engine desalinization rinse is required after the last flight of the day when deployed aboard ship, and/or when operating from bases within two miles of salt water or flown below 500 feet over salt

water. Prior to the wash, the engine shall be allowed to cool for a minimum of 40 minutes.

1. Armament — OFF/SAFE
2. FUEL — OFF
3. BATTERY — ON
4. APU — CONNECTED (If available)
5. Throttles — OFF
6. START switch — ON (for engine being rinsed) 30 second limit,
7. START switch — OFF
8. Repeat steps 6 and 7 for second engine.
9. Repeat steps 6 and 7 for first engine.
10. Repeat steps 6 and 7 for second engine.

The following dry cycle is optional except for cases when antifreeze has been added to fluids.

CAUTION

Allow starter to cool for 5 minutes.

1. START switch — ON (for engine being dried) 30 second limit.
2. START switch — OFF
3. Repeat steps 1 and 2 for second engine.

PRESSURE HOT FUELING

WARNING

Pressure hot fueling is prohibited when ordnance is onboard except during operational contingency.

1. Throttles — ENG IDLE.
2. Copilot/gunner — OUT (as required).
3. Copilot/gunner door — CLOSED.
4. Pilot door — CLOSED.
5. Helmet visor — DOWN.
6. TANK INTCON — OPEN.
7. CROSS FEED — OPEN.
8. FORCE TRIM — ON.

Fueling Personnel.

1. Helicopter — GROUND.
2. Fueling unit — GROUND.
3. Fire guard — POST.
4. Filler cap — REMOVE.
5. Fuel probe — CONNECT TO RECEIVER.
6. Fuel handle — ON.
7. Push and hold one of two PRECHECK REFUEL plungers on rim of fueling valve. Fuel flow should stop. Release plunger to allow flow. Repeat with other PRECHECK REFUEL plunger.
8. Fuel vent — CHECK FOR AIR FLOW.

CAUTION

Pressure fueling shall be discontinued immediately when any of the following is observed:

- Fuel flow does not stop on either PRECHECK REFUEL check.
- No air flow out of vent.
- Slow or no fuel flow.
- Fuel out of vent.
- Fuel seeping out around vent access panel.
- Fuel quantity gage shows no increase.
- Sound of structural deformation.

9. After satisfactory tests, continue fueling until automatic shutoff when cells are full.

10. Fuel handle — OFF.
11. Fuel probe — DISCONNECT.
12. Filler cap — INSTALL.
13. Grounds — REMOVE.

CAUTION

If fuel quantity gage shows below full quantity when pressure fuel shutoff occurs, a malfunction or failure exists within the fuel system.

Ground Crew Requirements.

Normal helicopter fueling crew.

Emergency Shut Down.

PILOT

1. Throttles — Close.
2. FIRE PULL — PULL (Both Handles).
3. BATTERY — OFF.
4. EXIT HELICOPTER.

PRESSURE FUELING.

1. BATTERY switch — ON.
2. TANK INTCON switch — OPEN.
3. BATTERY switch — OFF.
4. Helicopter — GROUND.
5. Fueling unit — GROUND.
6. Fire guard — POST.
7. Filler cap — REMOVE.
8. Fuel probe — CONNECT TO RECEIVER.
9. Fuel handle — ON.
10. Push and hold one of two PRECHECK REFUEL plungers on rim of fueling valve. Fuel flow should stop. Release plunger to allow flow. Repeat with other PRECHECK REFUEL plunger.
11. Fuel vent — CHECK FOR AIR FLOW.

CAUTION

Pressure refueling shall be discontinued immediately when any of the following is observed:

- Fuel flow does not stop on either PRECHECK REFUEL check.
- No air flow out of vent.
- Slow or no fuel flow.
- Fuel out of vent.
- Fuel seeping out around vent access panel.
- Fuel quantity gage shows no increase.
- Sound of structural deformation.

12. After satisfactory tests, continue fueling until automatic shutoff when cells are full.
13. Fuel handle — OFF.
14. Fuel probe — DISCONNECT.
15. Filler cap — INSTALL.
16. Grounds — REMOVE.

CAUTION

If fuel quantity gage shows below full quantity when pressure fueling shutoff occurs, a malfunction or failure exists within the fuel system.

LINE OPERATIONS.

The primary function of the flight line section is to ensure the safest and most efficient operation of all ground level activities including the elimination of foreign object damage (FOD). The Flight Line

Officer is charged with supervision of all such activities and is guided in this mission by OPNAV INST. 4790.2.

Limitations for Towing the Helicopter.

CAUTION

Towing the helicopter on the ground handling gear (ground handling wheels), on unprepared surfaces, at high gross weights may cause permanent set in the aft crosstube.

TOWING SPEED.

Towing speed will not exceed five miles per hour. Sudden stops and starts shall be avoided. Extreme caution shall be exercised when towing in a congested area.

WING WALKER.

NEW When towing a helicopter near hangars, obstructions, or other aircraft, a wing walker, equipped with a whistle, shall be stationed on each side of the helicopter to ensure adequate clearance. At night the wing walker will carry a flashlight or luminous wand and the helicopter position lights shall be turned on.

MOVEMENT.

During all phases of helicopter movement the main rotor blades shall be secured to the tailboom by means of a rotor tiedown.

Operation of Equipment:

Only qualified personnel shall operate towing equipment. Towing couplings shall be inspected prior to towing. Only approved tow bars shall be used. Ground handling wheels shall be installed in eye bolts provided on each landing gear skid tube, located forward of aft cross tube and forward of the forward cross tube. Reference maintenance manual for proper ground handling gear installation and operation.

WARNING

Care shall be taken to ensure that the ground handling pins are properly installed into eye bolts on the skid tube.

GROUND HANDLING GEAR TYPES.

Two types of ground handling gear can be used for moving the helicopter, forward mounted and aft mounted.

GROUND HANDLING GEAR. At gross weights of 13,560 pounds or less, the ground handling gear may be used for moving the helicopter. Early models do not have hand brakes. While in movement, each wheel assembly should be manned by a qualified aircraft handler. A qualified aircraft handler shall be positioned on the tail skid to take the weight off the front of the skid tube and to provide steerage. Two aircraft handlers may be utilized on the tail skid when wind/weight conditions warrant. The helicopter may be towed or pushed by hand if a sufficient number of aircraft handlers are available. Care should be exercised when lowering the helicopter onto the deck. The helicopter should be lowered slowly and assure all personnel are well clear. NEW

FORWARD MOUNTED GROUND HANDLING GEAR. The forward ground handling gear should be used when helicopter is at a high gross weight and/or forward of mid cg.

PROPER OPERATION WHEN FORWARD MOUNTED GROUND HANDLING GEAR IS USED. Install all ground handling gears in eye bolts on skid tube.

Extend aft ground handling wheel on one side only. Extend forward gear on same side. Extend remaining aft ground handling gear. Extend remaining forward mounted ground handling gear. Lower in reverse order.

WARNING

Do not raise or lower forward mounted ground handling gear unless the aft ground handling gear is raised.

One hand brake is installed on each aft ground handling gear assembly. During actual movement of the helicopter each hand brake shall be manned by a qualified aircraft handler.

A qualified aircraft handler shall be positioned on the tail skid to provide steerage. The helicopter may be towed or pushed by hand. Care should be exercised when lowering the helicopter onto the skids. The helicopter should be lowered slowly after assuring all personnel are well clear.

PART 4 — OPERATING LIMITATIONS

CAUTION

If aircraft rotor or engine limitations are exceeded, record on the VIDS/MAF. Further flight shall not be attempted until aircraft is inspected by qualified maintenance personnel.

INSTRUMENT MARKINGS.

Refer to figure 1-37 for instrument markings.

TORQUE LIMITS (ENGINE).

1. Refer to figure 1-37.
2. Duration of single engine operation at or above 49.4% torque shall be entered on the yellow sheet.

STARTER LIMITATIONS.

The duty cycle for the starter in this installation is as follows:

1. 30 seconds on — 1 minute off.
2. 30 seconds on — 1 minute off.
3. 30 seconds on — 30 minutes off.

After 30 minutes the duty cycle can start over again.

ROTOR BRAKE LIMITATIONS.

1. Do not apply rotor brake above 60% Nr.
2. Do not apply rotor brake below 25% Nr.
3. Do not move handle above detent while rotor is turning.
4. For rotor brake start: Release by 61%Ng.

AIRSPEED LIMITS.

Decrease airspeed 5 KIAS for each 1000 feet of density altitude above 4000 feet. Airspeed limits below 4000 feet density altitude are as follows:

1. 190 KIAS without stores.
2. 170 KIAS any configuration with stores.
3. 120 KIAS steady state autorotation.
4. Sideward flight 35 knots.
5. Rearward flight 30 knots.
6. Airspeed indicator is unreliable at airspeeds less than 40 knots.
7. Flight within the red area of height velocity diagram should be avoided (figure 1-38).
8. Canopy doors shall not be opened in flight at airspeeds in excess of 45 KIAS.
9. Auxiliary fuel tanks. Data not available at this time.

PROHIBITED MANEUVERS.

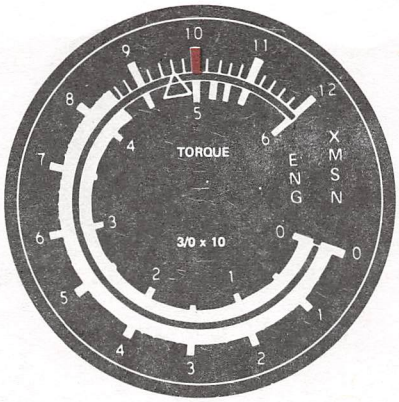
1. No acrobatic maneuvers permitted (acrobatic as defined in OPNAVINST 3710.7 series).
2. Flight below + 0.5 G is prohibited.
3. No practice full autorotations unless gross weight is 12,500 or less, and a qualified instructor, designated for full autorotations by the commanding officer, is in the cockpit.
4. Practice autorotation entries within the shaded areas of the height velocity diagram (figure 1-38) are prohibited.
5. No airstarts or manual fuel control operation above 15,000 feet.
6. No dual engine throttle chops above Vh (maximum level) flight speed attainable at MC power.
7. No solo flight permitted from the copilot/gunner cockpit.

MINIMUM CREW REQUIREMENTS.

NOTE

The view is restricted from the aft cockpit. With only one pilot in the helicopter a slight sideslip may be required to see the landing area during final approach.

FUEL GRADE
JP-5 OR JP-4



ENGINE TORQUE

- 0—45.2% — Normal Operating Range
- 45.2—53.1% — 30 Minute Limit
- 53.1—55.6% — 10 Second Limit

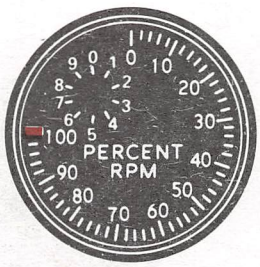
TRANSMISSION TORQUE

Dive — 65% Maximum for Any Airspeed Above The Maximum Airspeed Obtainable at 84.9% Torque

Maximum Continuous Power — 84.9% Up to Level Flight Maximum Speed

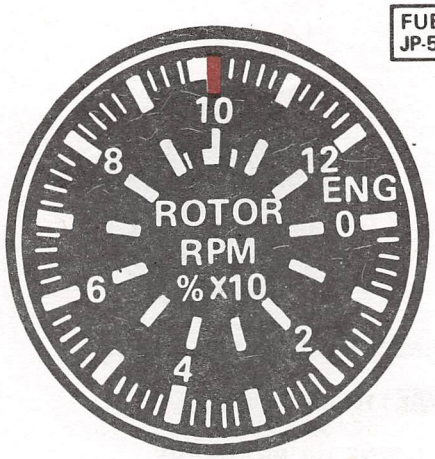
Maximum Power — 85—100% for 5 Minute Limit

- 100% Maximum



GAS PRODUCER TACHOMETER (Ng)

- 102% Ng — Maximum
- 102 — 103% — Transient Maximum (10 Seconds) (Engine logbook entry is required anytime 102% is exceeded.



ROTOR TACHOMETER (Nr)

POWER ON:

- 91% — Transient Minimum
- 97—100% — Normal Operation
- 98—100% — Dives
- 105% — Maximum
- 105 — 120% — Transient Maximum (10 Seconds)

POWER OFF:

- 84% — Transient Minimum
- 91—105% — Normal Operation
- 105 — 120% — Transient Maximum (10 Seconds)

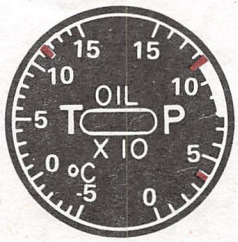
ENGINE TACHOMETER (Nf)

POWER ON:

- 97 — 100% — Normal Operation
- 98 — 100% — Dives
- 102% — Maximum
- 110% — Transient Maximum (10 Seconds)
- 102 — 110% — Transient Maximum (10 Seconds) (Engine logbook entry required anytime 102% Nf is exceeded)

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Figure 1-37. Operating Limits and Instrument Markings (Sheet 1 of 3)

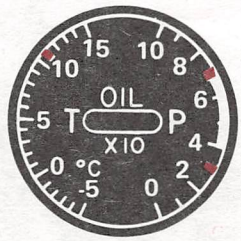


ENGINE OIL TEMPERATURE

116°C Maximum

ENGINE OIL PRESSURE

40 PSI — Minimum
80-115 PSI — Normal Operation
115 PSI — Maximum

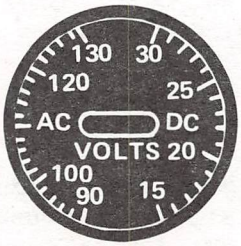


TRANSMISSION OIL TEMPERATURE

110°C Maximum

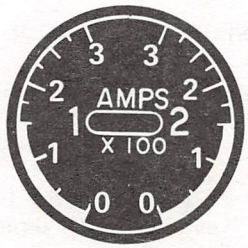
TRANSMISSION OIL PRESSURE

30 PSI — Minimum
40-70 PSI — Normal Operation
70 PSI — Maximum



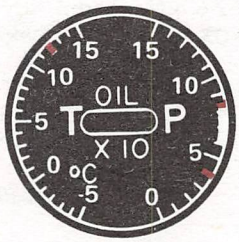
AC—DC VOLTMETER

Generator ON — 27 TO 28.5 Volts DC
AC Voltage — 113.5 ±5 Volts



DUAL AMMETER

0—150 Normal Operation

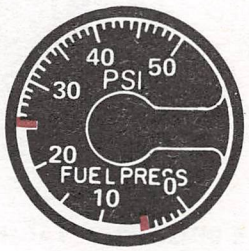


COMBINING GEARBOX OIL TEMPERATURE

116°C Maximum

COMBINING GEARBOX OIL PRESSURE

40 PSI Minimum
60—85 PSI Normal Operation
85 PSI Maximum



FUEL PRESSURE

5 PSI — Minimum
5-25 PSI — Normal Operation
25 PSI — Maximum

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Figure 1-37. Operating Limits and Instrument Markings
(Sheet 2 of 3)



INTER TURBINE TEMPERATURE

INFLIGHT:

200—789°C — Maximum Continuous Power
837°C — Maximum 30 Minute Limit
837°C — Light Illumination
838 — 900°C — Transient Acceleration
Maximum 5 Seconds.

STARTING:

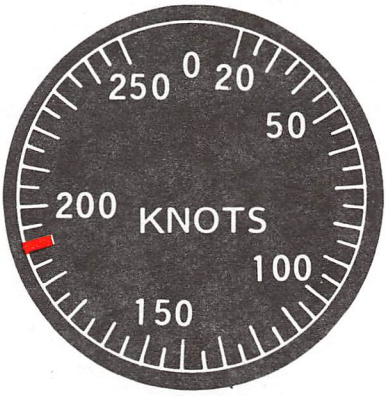
838 — 900°C — 5 Second Limit
901—1150°C — 2 Second Limit
Over 1150°C — Overtemp Inspection

NEW



DUAL HYDRAULIC PRESSURE

2940—3060 PSI Normal Operation
2200—3200 PSI Operation Range
Limits are for gage pressure variations with control or SCAS inputs. Steady LOW or HIGH pressure readings are an indication of hydraulic system malfunction.
3200 Maximum



AIRSPEED

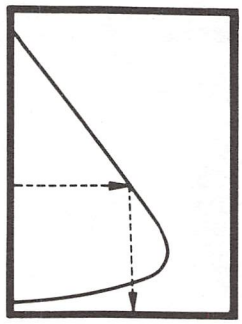
190 Knots Maximum

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Figure 1-37. Operating Limits and Instrument Markings
(Sheet 3 of 3)

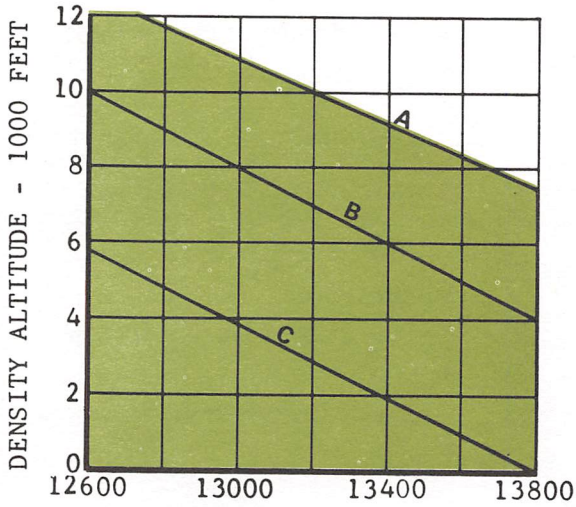
HEIGHT VELOCITY

DATA BASIS: ESTIMATED



CONDITION:

ALL CONFIGURATIONS
CALM WIND



ALTITUDE VS. GROSS WEIGHT LIMITS FOR HEIGHT – VELOCITY DIAGRAM

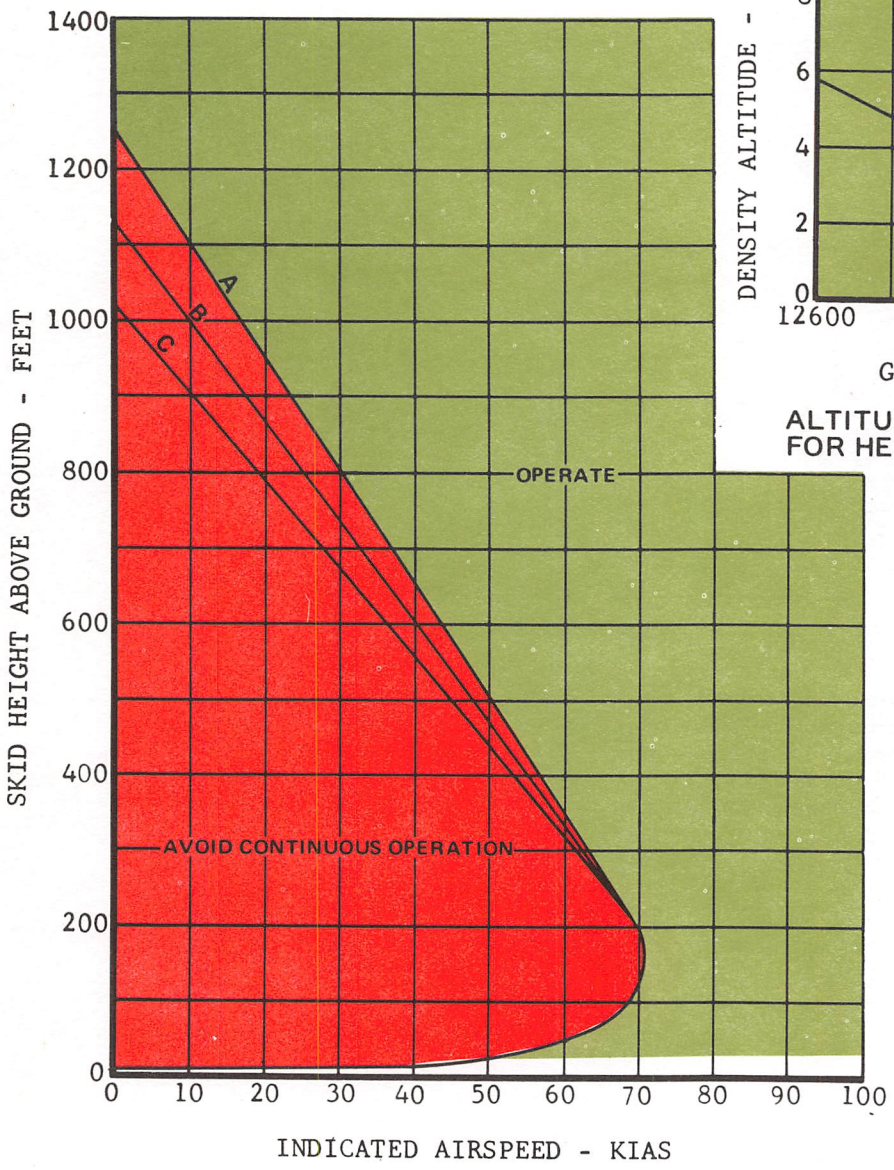


Figure 1-38. Height Velocity Diagram

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The minimum crew requirements for the AH-1T (TOW) helicopter consists of a pilot.

CENTER OF GRAVITY LIMITATIONS.

Refer to figure 1-39 for center of gravity limitations.

LATERAL CG LIMITATIONS.

Most right or most left lateral cg limits is 6.0 inches. Within this limit the helicopter may be flown with a single store on any station. Stores on both stations on the same side, with opposite side empty, can possibly exceed the lateral limit (depending on the particular stores).

NOTE

The most critical flight regime with the lateral cg at the most right station is a level flight at full power. The most critical flight regime with the lateral cg at the most left station is a 120 KIAS autorotation. If the lateral cg limits are exceeded there may not be sufficient lateral control margin to maintain balanced flight.

ACCELERATION G LIMITATIONS.

At 10,000 pounds gross weight: 0.5 to 3.5 G. At 14,000 pounds: 0.5 to 2.5 G (figure 1-40).

Refer to figure 1-40 for G limits.

FLIGHT WITH CROSSTUBE FAIRINGS REMOVED.

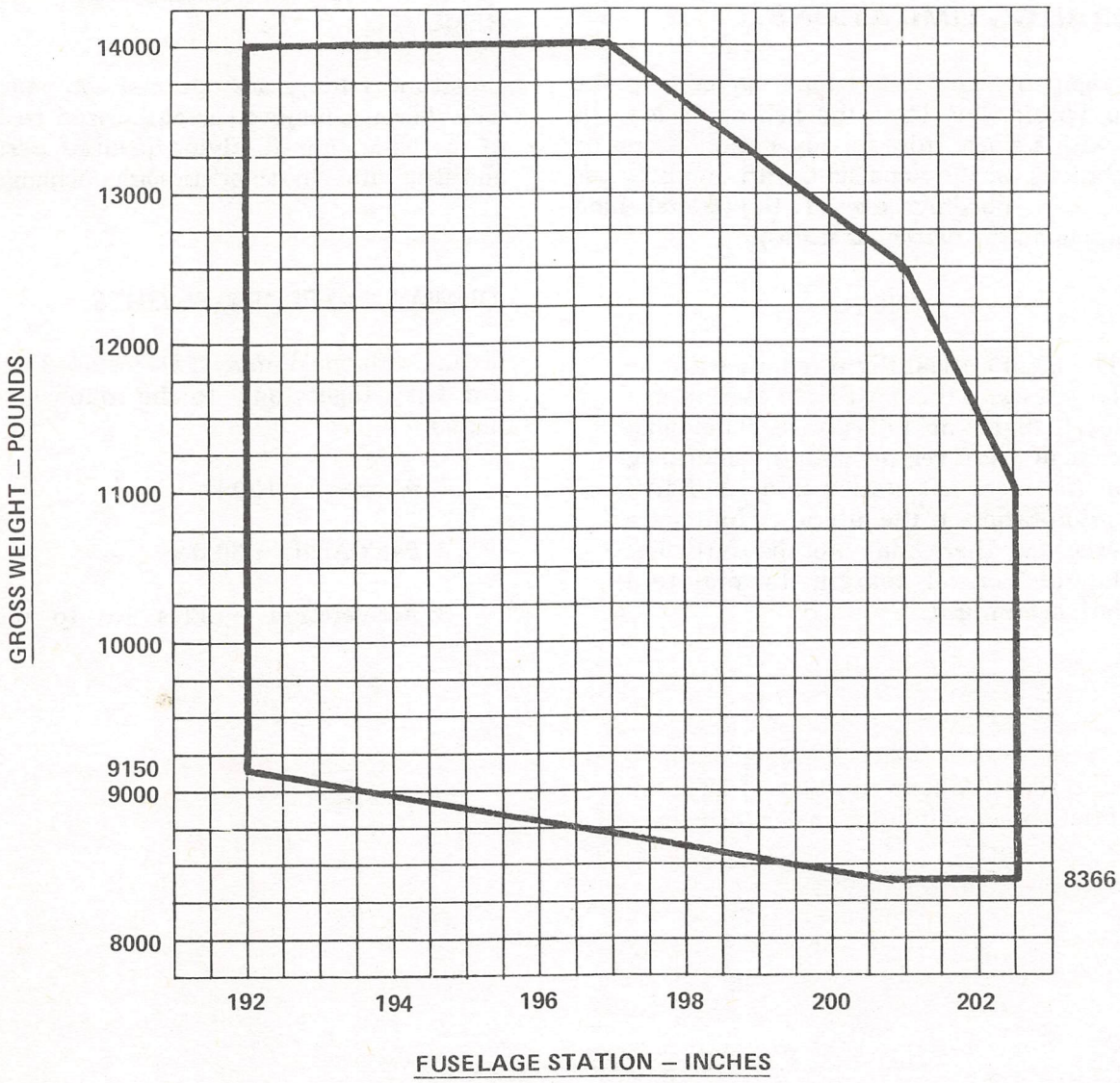
NEW NEW NEW

Crosstube fairings are optional equipment. Flight with fairings removed is authorized to the limits of the basic aircraft. Flying qualities, performance, and structural characteristics are unchanged.

DUMMY TSU FERRY FLIGHTS.

Flight with the dummy TSU installed is authorized for ferry flights only to the following maximum limits:

1. Airspeed — 120 kt.
2. Bank Angle — 30 deg.
3. Acceleration — Plus 1.0 to plus 1.5 G.



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Figure 1-39. Center of Gravity Diagram

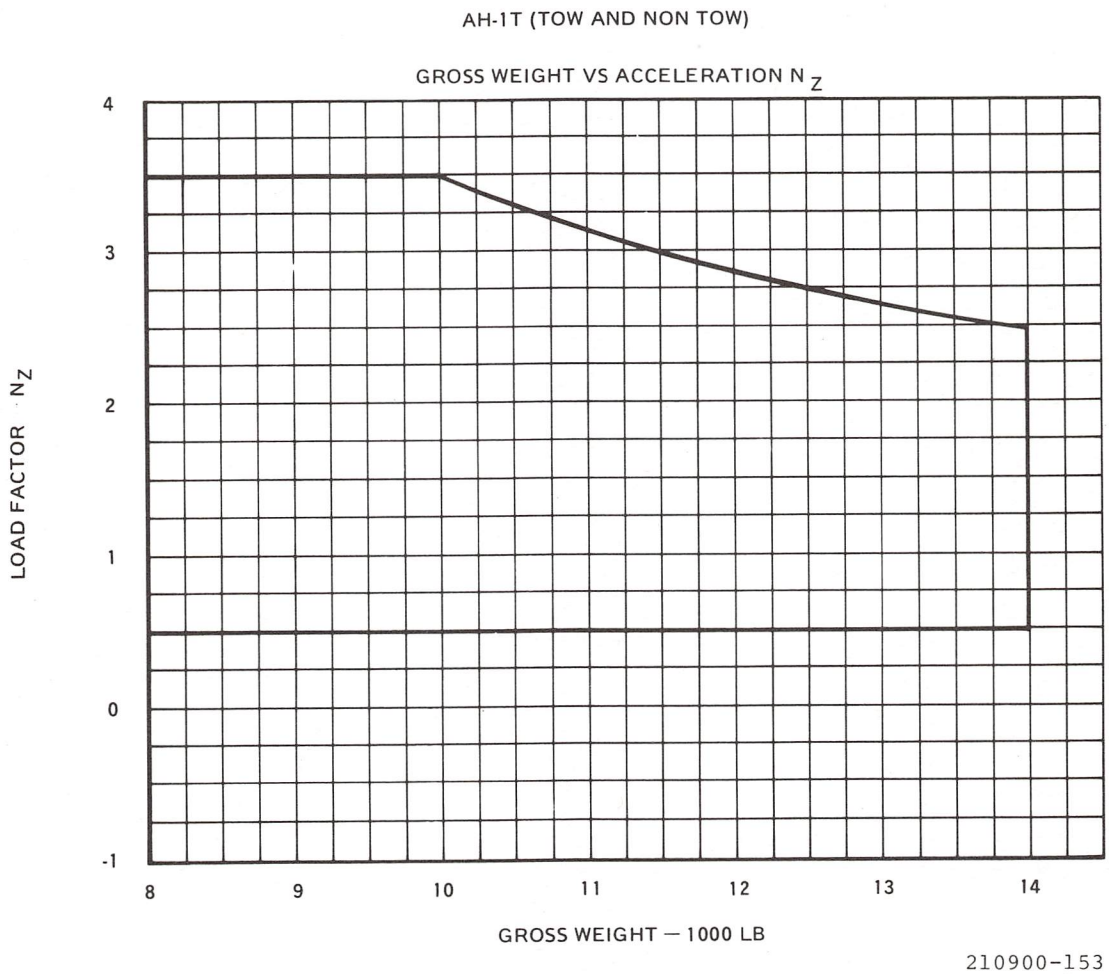


Figure 1-40. Gross Weight Vs Acceleration Nz

SECTION II — INDOCTRINATION

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INTRODUCTION.

The operating procedures contained in this manual will apply to AH-1T (TOW) helicopters when performing assigned missions within their capabilities. The information contained herein is to clarify, amplify, and standardize those areas where there is room for variance of interpretation by individual commands. The procedures contained herein cannot possibly cover every conceivable situation, but are intended to govern situations most frequently encountered. The safety and success of any mission are of paramount importance with precedence of actions depending upon the existing situation.

GROUND TRAINING SYLLABUS.

A ground training program shall be established which will ensure thorough training and a high degree of readiness for all flight personnel. The ground training syllabus which follows is to be used as a guide and represents the minimum requirements to be met prior to completing the familiarization stage in the flight training syllabus as set forth by the type commands.

PILOT GROUND TRAINING.

1. Every pilot checking out in the AH-1T (TOW) helicopter will be required to complete a course of instruction in the AH-1T (TOW). This course of instruction will vary from about 20 hours to the maximum of 40 hours depending upon the pilot's background.
2. A written examination will be given on the NATOPS Flight Manual and NWP series publications.
3. Instruction and examination must be completed on the following subjects prior to completion of the flight familiarization phase:
   a. Helicopter operational performance (flight characteristics, systems operation, etc.)
   b. Weight and balance.
   c. Publications (FAA, Tactical, Technical and associated, etc.)
   d. Communications.
   e. Survival and first aid.
   f. Search and rescue.
   g. Flight planning, fuel management.
   h. Helicopter navigation.
   i. Flight safety.
   j. Emergency procedures.

PILOT FLIGHT TRAINING.

A flight training syllabus shall be established by each command to accomplish maximum training for the mission and tasks assigned. The syllabus must be flexible and tailored to fit the situation and the varying nature of the tasks and commitments. The flight training syllabus will contain the following phases: familiarization, formation, instruments, navigation, night, shipboard, and special categories.

FLIGHT CREW DESIGNATION, QUALIFICATIONS AND REQUIREMENTS.

The flight crew qualifications and requirements as set forth in the following paragraphs are minimums and are not to be interpreted as limiting in any way the establishment of higher requirements by proper authority.

Designation.

A naval aviator or aviation pilot will be designated as qualified in model only after he has previously been designated as a helicopter pilot under the provisions of OPNAVINST 3710.7 series. A pilot who has qualified in one of the helicopter classifications shall have a certificate thereof, signed by the qualifying authority. This certificate will state the model helicopter and modification thereto in which he is qualified and shall be placed in his Aviator's Flight Log Book, Officers Qualification Jacket, or Enlisted Service Record Book, as appropriate.

Designating Authority.

Commanding officers, or higher authority in the chain of command are empowered to designate pilot's qualified in model and issue certification thereto. The immediate superior in command to the commanding officer, or higher authority, may assume the function. The authority assuming the function shall issue appropriate instructions.

Qualifications.

PILOT QUALIFIED IN MODEL (PQM).

A pilot qualified in model must have satisfactorily completed a Flight Training Syllabus or demonstrate comparable proficiency to include the capability of executing all assigned missions and tasks, and must further meet the requirements as set forth in detail in OPNAVINST 3710.7 series, and completed satisfactorily a NATOPS evaluation.

MISSION COMMANDER.

A mission commander shall be a properly qualified Naval aviator designated by appropriate authority. The mission commander may exercise command over single Naval aircraft or formations of Naval aircraft. He shall be responsible for all phases of the assigned mission except those aspects of safety of flight which fall under the perogatives of individual pilots in command. Requirements for designation as mission commander will be outlined by appropriate authority.

SECTION LEADER.

A section leader must be a pilot qualified in model. In addition, this pilot must be fully qualified to lead a section under all conditions in performance of any of the squadron tasks.

DIVISION LEADER.

A division leader must be a pilot qualified in model with no less than 600 total flight hours. Of this total, 200 hours must be in helicopters of which 50 hours must be in squadron model.

FLIGHT LEADER.

A flight leader must be a qualified division leader with no less than 750 total flight hours. Consideration will be given to rank and experience, when warranted, to allow for exceptions by the commanding officer.

COPILOT/GUNNER.

A copilot/gunner is a pilot who has completed the FAM stage and all FRONT COCKPIT ORDNANCE requirements.

FUNCTIONAL CHECK PILOT.

A FCP must have a minimum of 100 hours in model PQM and be designated in writing by the unit commanding officer.

CREW REQUIREMENTS.

1. A pilot designated as qualified in model shall command the helicopter and occupy one of the control positions on all service and combat flights.

2. A transition pilot (pilot under instruction), rated safe for solo, may command the helicopter

on all types of operational training missions within his capabilities and which, in the opinion of the commanding officer, is best suited to instill pilot confidence and helicopter command responsibilities.

3. On all flights, a qualified observer may occupy the forward seat to ensure adequate visual surveillance. A qualified observer is anyone who is thoroughly briefed in cockpit conduct and safety, to include intercom system operation and lookout responsibilities.
4. All instructional flights will be under the direct supervision of a designated PQM. Familiarization stage training will be conducted only under VFR conditions.

Currency.

ANNUAL FLYING AND CURRENCY REQUIREMENTS.

To ensure that the skill of naval aviators is maintained at an acceptable standard of readiness for fleet operations, the annual flying requirements as set forth in OPNAVINST 3710.7 series must be adhered to by all active duty naval aviators.

NEW NEW NEW NEW NEW NEW

CREW REST REQUIREMENTS.

Pilots should not be scheduled for more than 6-1/2 hours of normal flying per day. Eight hours for 1 day is permissible provided a minimum of 2 hours crew rest is taken between each 4 hour period of flight. A basic crew day of 12 hours from first brief to last shutdown shall not be exceeded. Minimum ground time after extended flight operations shall be sufficient time for crew members to eat and obtain at least 8 hours of uninterrupted rest. Exceeding the above crew rest requirements may result in crew fatigue causing impaired judgement and reduced performance.

NATOPS EVALUATION.

On assignment to another unit a PQM will not be required to receive a NATOPS evaluation if the log book entry and pilot's qualification jacket indicates successful completion of the check within the last 12 months.

WAIVERS.

Unit commanders are authorized to waive in writing minimum flight and/or training requirements where recent experience in similar model helicopters warrants.

PERSONAL FLYING EQUIPMENT.

The latest available type of flight safety and survival equipment listed below shall be worn by all pilots and crewmembers on all flights unless a tactical combat environment or military exigency require on site deviations. See OPNAVINST 3710.7 series for further details.

All Flights.

1. Protective helmet.
2. Flight safety boots/field shoes.
3. Nomex gloves.
4. Nomex flight suit.
5. Identification tags.
6. Survival knife and sheath.
7. Personal survival kit.
8. Signalling device for all night flights and for all flights over water or sparsely populated area.
9. Parachutes will be utilized in accordance with OPNAVINST 3710.7.

Over Water Flights.

1. Life preservers shall be worn.
2. Anti-exposure suits shall be provided for all personnel in accordance with OPNAVINST 3710.7 series.

Night and Instrument Flights.

1. A flashlight shall be carried in the helicopter.
2. Approach plates.
3. Maps.

SECTION III — NORMAL PROCEDURES

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PART 1 — FLIGHT PREPARATION

MISSION PLANNING.

Introduction.

Adequate and thorough planning of the flight is necessary to assure the successful completion of any mission.

Factors Affecting Helicopter Lift Capability.

TEMPERATURE.

High free air temperatures (fat) result in increased inlet air temperatures which have an adverse effect on the power output of gas turbine engines. On the T400-WV-402 engine, one percent loss in horsepower can be expected for each 1 degree celsuis above standard day temperature. For each 2 degrees celsius above standard, approximately 0.1 percent decrease in GAS PROD (Ng) rpm for maximum power can be expected. An increase in (fat) at a constant pressure altitude causes an increase in density altitude, which results in decreased hover performance.

HUMIDITY.

The effect of humidity on gas turbine engines is negligible.

ALTITUDE.

Altitude has a marked effect on the performance of all aircraft engines. Air density and temperature decrease as altitude increases. As air density decreases, the mass flow of air through the gas turbine decreases. However, the gas turbine operates more efficiently at the lower temperatures encountered at high altitudes. At altitude, the power output of gas turbine engines decreases as evidenced in the cockpit by a decrease in the torque pressure reading and the specific fuel consumption (engine fuel consumption in pounds per hour divided by engine shaft horsepower) decreases due to increased engine efficiency. With the collective pitch control set, the ENG RPM (Nf) will begin to droop as higher altitudes are reached. Operating rpm can be reestablished by reducing the angle of attack of the blades (by decreasing collective).

WIND.

If a helicopter can takeoff and land into a steady wind, its payload can be increased because less power is required for the same flight performance with wind than without wind. Helicopters operating from the decks of ships underway are in an excellent position to take advantage of the relative wind generated by the ship movement. However, an allowance for deck edge and elevator turbulence must be made. Consideration must be given to winds in the landing zone ashore when at maximum gross weight conditions.

GROUND EFFECT.

For hovering flight closer than one-half rotor diameter to the earth, the lifting ability of a helicopter is increased by ground effect. Since the power required to hover increases with an increase in height above the ground, the helicopter can hover at heavier gross weights in-ground effect (IGE) than out-of-ground effect (OGE).

Weight Limitations Applicable to Helicopters.

THE AERODYNAMIC — POWER WEIGHT LIMIT.

Increases in ambient air temperature and/or altitude restrict lift capability of the helicopter because a decrease in air density will result in decreased power available from the engine and a loss of rotor efficiency. The relationship of lift capability to atmospheric conditions is found in the performance charts in section XI. While flight operations based on HIGE limit will permit an increase of lift capability, HOGE weight computations will be used for normal training operations. Exceptions to this will be necessary when operational and service flights are made under favorable conditions which require carrying payloads at an altitude beyond the capability of the helicopter to HOGE. Sliding landings and takeoffs will further increase payloads but require a surface of sufficient length in an area free of obstacles. HOGE and HIGE should be computed prior to takeoff or landing. Operations based on these exceptions should be made only under carefully calculated requirements.

WEIGHT AND BALANCE.

The AH-1T (TOW) is a class 1B aircraft for weight and balance purposes (the CG limits can be exceeded by some normal loads) and therefore needs loading control. The Manual for Weight and Balance, NA01-1B-40, includes guidance and data for the specific serial number aircraft to insure proper loading control.

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The maximum allowable gross weight for takeoff is 14,000 pounds and must not be exceeded. This weight is determined by structural and flying qualities flight tests done by NAVAIR and Bell. CG limits are shown in figure 1-39. The lateral CG limit is 6.0 inches right or left.

Form 365F of NA01-1B-40 is not normally required for each flight if a current form is on file. See OPNAVINST 3710.7 series for further information. The AHC will ensure that the maximum allowable gross weight, longitudinal and lateral limits will not be exceeded during flight.

General Precautions.

Special care will be exercised to avoid flying over populated areas, civilian airports, turkey and chicken farms, etc. In all cases conformance with existing regulations is mandatory.

Requirements for Mission Planning.

Mission planning has two requirements. The first requirement is for pilot and operations personnel to calculate normal and emergency helicopter operating capabilities concurrent with existing ambient conditions and mission requirements prior to every flight on a daily basis. The second requirement is preparation of planning documents for a future helicopter assault or support mission and is normally prepared from weather summaries and predicted weather in the area to be considered. Weather summaries suitable for preparation of such estimates can be prepared or obtained by any authorized weather facility with a forecasting capability. Fuel reserve for all flights shall be computed so as to land with no less than 10% or 20 minutes, whichever is greater.

NEW

COMPUTATION CARD.

The computation card for determining capabilities (figure 3-1) shall be used for mission planning. Deviations and substitutions may be made within the standard form. Substituting HIGE or HOGE is an example. HOGE computations should be made of the mission requirements in order to have this information readily available during flight.

BRIEFING.

The pilot is responsible for briefing the crew. This briefing shall ensure complete understanding of the mission. The pilot shall give specific instructions to cover special situations that may occur.

A briefing guide will be used. On training flights, the appropriate syllabus guide should be used. Each pilot will maintain a kneepad and record all flight numbers, call signs and other data necessary to successfully assume the lead and complete the assigned mission. The briefing guide will include the following items.

GENERAL.

1. Helicopter call signs, event.
2. Lead/alternates.
3. Fuel load, stores, gross weight.
4. Start, taxi, takeoff times.
5. Takeoff data, rendezvous.

TARGET OR DESTINATION.

1. Primary.
2. Secondary.
3. Operating area, targets.
4. Control agency.
5. Time on station or over target.

NAVIGATION/FLIGHT PLANNING

1. Duty runway.
2. Climbout.
3. Operating/restricted areas.
4. Obstacles to flight.
5. Mission plan.
6. Cockpit coordination.
7. Bingo/low fuel.
8. Holding.
9. Approach/lighting.
10. GCA/missed approach.
11. Recovery.
12. Divert/emergency fields.

COMMUNICATIONS

1. Frequencies.
2. Agencies.

		WIND	KNOTS
1.	TAKEOFF PRESSURE ALT _____ FT. FAT _____ °C. •		
2.	NO-WIND HOGE MAX GRWT		_____ LB
3.	WIND CORRECTION	(+)	_____ LB
4.	HOGE MAX GRWT/WIND		_____ LB
5.	OPERATING WEIGHT (BASIC WT., CREW, MISC.)	(-)	_____ LB
6.	PAYLOAD PLUS FUEL		_____ LB
7.	RANGE OUT _____ NMI, TIME/FUEL OUT _____ MIN.		_____ LB
8.	FUEL FOR START, TO, AND RESERVE		_____ LB
9.	TOTAL FUEL REQUIRED		_____ LB
10.	TOTAL FUEL ABOARD (GAGE READING)	(-)	_____ LB
11.	PAYLOAD OUT _____ LB		
12.	LANDING PRESSURE ALT. _____ FT., LAND TEMP _____ °C WIND		_____ KN
13.	LANDING NO-WIND HOGE MAX GRWT		_____ LB
14.	WIND CORRECTION (LANDING)	(+)	_____ LB
15.	LANDING HOGE MAX GRWT/WIND		_____ LB
16.	FUEL OUT	(+)	_____ LB
17.	*MAX GRWT PERMITTED AT TO DUE TO LANDING CONDITIONS		_____ LB

*If this weight is less than line (4) above, substitute this weight in line (4) and recompute payload.

NOTE: This form may be abbreviated for daily local area operation.

Figure 3-1. Computation Card

3. Procedure/discipline.

4. IFF.

5. Nav Aids.

6. Signals.

WEAPONS

1. Loading.

2. Arming.

3. Hot ordnance routes.

4. Pattern.

5. Switches.

6. Airspeeds.

7. Minimums.

8. G versus weight.

9. Duds, hung ordnance, de-arm, jettison.

10. Safety.

NEW 11. Crew coordination.

WEATHER

1. Local, enroute, destination/forecast.

2. Alternates.

3. Winds.

EMERGENCIES

1. Aborts.

2. Radio failures.

3. Nav aid failures.

4. Loss of visual contact/VMC/IMC.

5. Inadvertent IMC.

6. Lost procedures.

7. SAR.

8. Helicopter/system failures.

9. Crew coordination. NEW

SPECIAL INSTRUCTIONS

1. Intelligence.

2. Safety.

3. Reports/authentication.

DEFRIEFING.

A proper debriefing conducted under tactical or training conditions can be the most important part of a flight. Mistakes can be discussed in an atmosphere free from distractions. Under tactical conditions debriefing is a primary source of information leading to the location of targets, distribution of troops, and many other important considerations. An outline should be followed when debriefing a flight. This outline should contain all of the items for briefing plus the following:

1. All unusual circumstances encountered.

2. Discrepancies arising.

3. Constructive criticism can be conducted in such a manner that all concerned can participate and present their ideas on the conduct of the flight.

PART 2 — SHORE-BASED PROCEDURES

INTRODUCTION.

Shore-based procedures are discussed in this chapter to cover as many operational situations as possible.

SCHEDULING.

The commanding officer, or his designated representative, is responsible for the promulgation of the flight schedule when based ashore. The

flight schedule, when published, becomes an order of the commanding officer. The flight schedule will contain sufficient information to assure all preparations relative to flight can be accomplished in a smooth and timely manner. The minimum essential items which shall be included on the flight schedule are found in OPNAV INST 3710.7.

GROUND OPERATIONS.

Preflight Inspection.

Prior to flight, the pilot and aircrewmen shall conduct a complete visual check of the helicopter.

Fire Guard.

Prior to starting the engine, a qualified fire guard shall be stationed near the engine and remain in readiness with a fire bottle until the engine is operating.

WARNING

- The fire guard shall remain clear of the exhaust and compressor blade area.
- Ear protection and goggles that provide adequate peripheral vision shall be worn by flight line personnel.

Helicopter Acceptance.

The pilot in command shall ensure, prior to acceptance, that the helicopter is satisfactory for safe flight and can accomplish the assigned mission. The pilot will review the VIDS/MAF discrepancies from the last ten flights and all previous outstanding discrepancies. The pilot shall conduct a thorough preflight inspection.

1. The pilot shall ensure that the plane captain has conducted a standard daily preflight as set forth in the NAVAIR 01-H1AAB-6 series and signed the yellow sheet prior to each flight.
2. The pilot, when satisfied with the yellow sheet information, will sign applicable portions of the yellow sheet.

DISCREPANCY REPORTING.

Immediately following each flight, the pilot shall note all discrepancies in detail by completing the applicable items of the VIDS/MAF form in accordance with OPNAVINST 4790.2 series. To aid in descrepancy analysis, specific information such as position of controls, movement of controls and results, instrument readings, etc., should be recorded in flight, if practical, to be included on the yellow sheet. Maintenance troubleshooters should be available for consultation. The pilot will ensure that he has conveyed his complete knowledge of the discrepancy orally and in writing.

EXTERIOR INSPECTION.

On pilot's first two FAM hops, exterior preflight inspection shall be conducted in accordance with MRC cards. Figure 3-2 represents minimum preflight inspection for all flights.

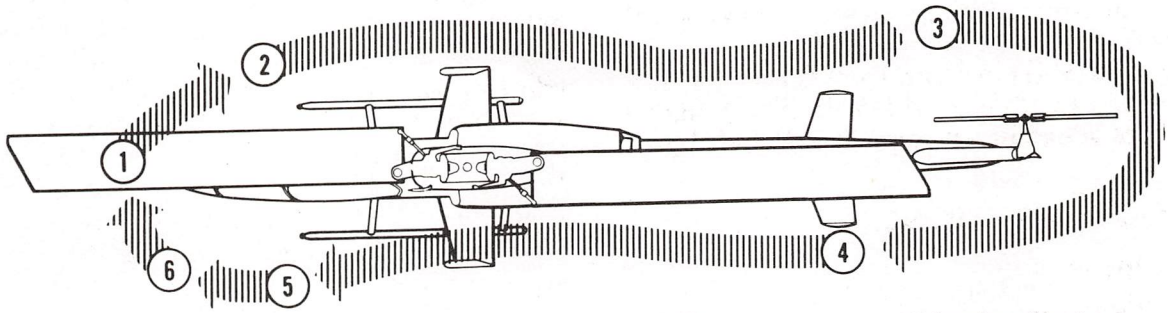
PRE-ENTRY INSPECTION.

NEW NEW NEW NEW NEW NEW NEW NEW

1. Armament cb switches — UP/INBD.
2. Armament switches — OFF/SAFE.
3. FIRE handles —IN.
4. FIRE extinguishers — OFF.
5. BATTERY — OFF.
6. INVERTER — MAIN.
7. FUEL switches — ON.
8. SCAS — ON.
9. ANTI COL LT — ON.
10. FUEL QTY — CHECK.
11. SCAS — OFF.
12. FUEL switches — OFF.
13. INVERTER — OFF.
14. BATTERY — OFF.
15. Rotor tiedowns — REMOVE/STOW.
16. Engine covers — REMOVE/STOW.

If single pilot operation is to be conducted, the following items shall be checked in the copilot/gunner cockpit:

1. Safety bolt and shoulder harness — SECURE.
2. Loose equipment — SECURE.
3. Canopy jettison handle pin — IN.
4. UHF EMER — OFF, COVERED.



1 Windshield
Searchlight.

2. Pilot canopy for proper operation and latching.
Hydraulic fluid level and leaks.
Fuel quantity and cap security.
Right side skid tube and cross tubes.
Right wing.
Transmission oil level.
Engine No. 2 oil level.
Combining gearbox oil level.
Oil or fuel leaks in transmission and engine compartment right side.
All access doors and panels secured right side.
Avionics and battery compartment.
Main rotor blades from right side.
Elevator for damage right side.

3. Tail rotor.
Tail skid.
Main rotor blade tiedown removed.

4. 42 degree gearbox oil level and leaks.
90 degree gearbox oil level.
Elevator for damage left side.
Fuselage and tailboom left side.
Avionics compartment.
Oil or fuel leaks in transmission and engine compartment left side.
Fire bottles.
Engine No. 1 oil level.
Hydraulic fluid level.
Rotor mast and head.
Pitot tube cover removed.
All access doors and panels left side secure.
Left skid tube and cross tubes.
Left wing.

5. Gunner canopy for proper operation and latching.

6. Turret gun drive assembly.
Rear gun mount.
Declutcher-feeder cannon plug.
Elevation and azimuth brakes.
Turret cowling.
Muzzle and mid-barrel clamps.
Telescopic sight unit.

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Figure 3-2. Exterior Inspection

5. INTER panel — SET.

6. ENG 1 GOV, ENG 2 GOV — AUTO.

7. INSTR LT and CSL LT — OFF.

8. SRCH LT — OFF.

9. F TRIM — ON.

10. ELEC PWR — ELEC PWR.

11. WG ST JTSN — OFF, COVERED.

12. PILOT OVERRIDE switch — OFF.

13. Armament switches and controls — AS REQUIRED.

14. Canopy door — CLOSE AND SECURE.

INTERIOR INSPECTION—COPILOT/GUNNER.

These items represent minimum inspection for all flights.

1. Canopy door — AS DESIRED.

2. Loose equipment — STOW AND SECURE.

3. Pedals — ADJUST.
4. Safety belt and shoulder harness — FASTEN.
5. Inertial reel — CHECKED (including self-locking feature).
6. Canopy jettison handle pin — IN.
7. PILOT OVERRIDE — OFF.
8. Armament switches and controls — AS REQUIRED.
9. UHF EMER — OFF, COVERED.
10. INTER panel — SET.
11. ENG 1 GOV, ENG 2 GOV — AUTO.
12. INSTR LT and CSL LT — AS REQUIRED.
13. F TRIM — ON.
14. SRCH LT — OFF.
15. ELEC PWR — ELEC PWR.
16. WG ST JTSN — OFF, COVERED.
17. Inform pilot — COPILOT/GUNNER CHECKLIST COMPLETE.

INTERIOR INSPECTION — PILOT.

1. Rotor tiedowns — REMOVED.
2. Seat and pedals — ADJUST.
3. Shoulder harness — ADJUST.
4. Inertial reel — CHECKED (including self-locking feature).
5. Canopy door — AS DESIRED.
6. Right circuit breakers — IN.
7. Lights — AS DESIRED (ANTI-COL — ON).
8. PITOT HTR — OFF.
9. RAIN RMV — OFF.
10. COMPASS — SLAVED.
11. IFF — OFF.
12. TACAN — OFF.
13. ADF — OFF.
14. KY-28 — OFF.
15. UHF — OFF.
16. FM — OFF.
17. ALE-39 ARM switch — SAFE.
18. ALE-39 PWR switch — OFF.
19. APR-39 — OFF.
20. Clock — SET AND RUNNING.
21. RADAR ALTITUDE altimeter — OFF.
22. ALT — SET.
23. FIRE EXT — OFF.
24. Canopy jettison handle pin — IN.
25. CODE HOLD — OFF.
26. FIRE PULL handles — IN.
27. ECU/VENT — OFF.
28. MASTER ARM — OFF.
29. KY-28 — OFF.
30. RADAR BEACON — OFF.
31. ALQ-144 — OFF.
32. EMERGENCY JETTISON SELECT — OFF.
33. INTER panel — AS DESIRED.
34. SCAS POWER — OFF.
35. SMOKE ARM — OFF.
36. ENG 1, ENG 2 FUEL — OFF.
37. TANK INTCON — OPEN.
38. CROSS FEED — OPEN.
39. ENGINE 1, ENGINE 2 GOV — AUTO.
40. ENGINE 1, ENGINE 2 PART SEP — AUTO.
41. NO. 1 GEN, NO. 2 GEN — OFF.
42. INVERTERS — OFF.
43. HYD — ON.

44. NON-ESS BUS — NORMAL.
45. FORCE TRIM — ON.
46. BATTERY — OFF.
47. AUX FUEL — OFF.
48. Left circuit breakers — IN, TOGGLE SWITCHES INBOARD.
49. SRCHLT — OFF.
50. Collective strap — OFF.
51. Copilot/gunner checklist — COMPLETE.

INTERIOR INSPECTION (NIGHT FLIGHTS). In addition to interior inspection for all flights the pilot shall inspect the following:

1. Flashlights — AVAILABLE.
2. All interior lights — CHECK OPERATION.
3. All exterior lights — CHECK OPERATION.

PRE-START CHECKLIST.

1. Helmet — ON.
2. BATTERY — ON, WITH OR WITHOUT APU (22 vdc minimum for start).

WARNING

If battery voltage is below 22v, replace the battery before proceeding with start up. A low voltage battery will cause battery damage, and possible damage to the aircraft and/or injury to personnel.

3. APU (if required) — CONNECT (check voltage 26 minimum, 29 maximum).
4. INVERTERS — MAIN (AC Voltage — 113.5 ± 5).
5. Rotor brake — ON (if desired) check light.
6. FIRE WARN — TEST.

NOTE

Do not hold test switch on for more than 15 seconds.

7. FUEL GA TEST — PRESS.
8. MASTER CAUTION, CAUTION-ADVISORY panel — TEST and RESET.

A qualified pilot shall be in the pilot seat whenever the engine and rotor are started. Prior to start the rotor tiedowns shall be removed and the surrounding area clear of unnecessary personnel, equipment and obstructions. The pilot shall acknowledge plane captain/fire guard all clear signals prior to start. Helicopter tiedowns shall be removed with caution when the engines and rotors are operating and only upon proper signal.

CAUTION

Tail winds in excess of 10 knots with external power or battery start may result in smoke, tailpipe fire, and/or excessive ITT.

To help equalize engine starter wear, start the number one engine on odd calendar days and the number two engine on even calendar days.

9. Throttles — OPEN, CHECK IDLE STOP, OFF.
10. Throttle friction second engine to be started — SET.
11. RPM — DECR (5 seconds).
12. FUEL first start engine — ON (Pressure 5 - 25 PSI, FUEL BOOST lights out).
13. Main rotor — CLEAR.
14. VOLTS DC — MINIMUM 22 VOLTS.

START CHECKLIST.

If for any reason a starting attempt is discontinued, allow the engine to come to a complete stop and then accomplish a 15 second motoring run. Repeat the complete starting sequence.

If INLET TEMP fails to rise within 10 seconds after opening the throttle, close the throttle, START OFF, and FUEL OFF. Allow the fuel to drain for one minute and then accomplish a 15 second motoring run. If battery voltage will not rise above 15.5 vdc after engaging starter, turn the starter off and utilize an external power source. Do not move the START switch through the off position and engage the other starter.

If rotor slipping occurs after the starter is engaged and the decision is made to continue the start, the rotor brake shall be released immediately. If rotor slipping occurs in winds greater than 35 knots, the start shall be aborted.

1. START first engine — ON.

   a. Observe a positive indication of oil pressure.

   b. When GAS PROD (Ng) passes 12%, check battery voltage; if above 15.5 vdc smoothly roll the throttle to the low side of the IDLE STOP.

   c. Monitor INLET TEMP to prevent engine overtemperature.

CAUTION

Prepare for a hot start if ITT approaches 850 degrees C. For ITT above 837 degrees C, log temperature and time.

838 - 900 degrees C — 5 second limit.

901 - 1150 degrees C — 2 second limit.

over 1150 degrees C — Overtemperature inspection.

2. As GAS PROD (Ng) passes 50%, START — OFF.

3. Rotor brake — RELEASE (below 61% GAS PROD (Ng).

WARNING

If severe main rotor flapping occurs due to high/gusty winds, apply cyclic into wind, as required, to prevent mast bumping. If mast bumping occurs, shut down helicopter.

4. Temperature/pressures — CHECK (Combining gearbox, transmission and engine).

5. APU — DISCONNECT AS REQUIRED.

6. GEN — ON, CHECK AMPERAGE.

7. IDLE STOP — RELEASE.

8. Throttle — INCREASE TO 85% ENG RPM (Nf, SET FRICTION.)

NOTE

Do not operate engine in excess of 71% Ng until engine and combining gearbox temperature reach plus 15 degrees C.

9. Warning/CAUTION lights — CHECK.

10. Flight control — CHECK.

    a. Check cylic movement — Displace cyclic forward, aft, left and right approximately 2 inches. Note tip path plane correlation.

    b. Directional pedals — Displace left and right approximately 1 inch.

    c. Collective — Raise collective sufficiently to note ROTOR RPM (Nr) droop.

11. FORCE TRIM — CHECK.

    a. With FORCE TRIM ON — Displace cyclic and pedals; if operating properly, controls will return to original position. Check that gradient force is equal in all movements of cyclic and pedals. Ensure that force trim will hold controls in displaced position by utilizing the cyclic stick force trim switch.

    b. Turn FORCE TRIM OFF on pilot console. No motoring of cyclic or pedals is allowed.

    c. Displace cyclic and pedals to ensure force gradient springs have released.

    d. FORCE TRIM — ON.

12. Hydraulic check — Move the HYD switch to the SYS. 1 OFF position, NO. 1 HYDR PRESS light is illuminated on the CAUTION ADVISORY panel and HYD PSI 1 near zero. Tail rotor pedals will be stiff with collective and cyclic normal. Make all movements slow and small. Switch to the SYS. 2 OFF position, NO. 2 HYDR PRESS light illuminates and HYD PSI 2 near zero. HYD switch to ON and all caution lights should be out, all controls normal. MASTER CAUTION light will illuminate each time a caution segment light illuminates.

13. AMPS — CHECK (Below 150 amps).

14. FUEL second engine — ON.

15. Throttle friction second engine — OFF.

16. START second engine — ON.

    a. Observe a positive indication of oil pressure.

b. When GAS PROD (Ng) stabilizes (minimum 12%) smoothly roll the throttle to the low side of the IDLE STOP.

c. Monitor INLET TEMP.

17. As GAS PROD (Ng) passes 50% START — OFF.

NEW 18. IDLE STOP — RELEASE.

19. Throttle — Continue to increase to 85% ENG RPM (Nf). Ensure that ENG RPM (Nf) does not exceed first started engine. The torque of the first engine should drop off slightly as the ENG RPM (Nf) needles marry. A non-engaged engine is indicated by ENG RPM (Nf) slightly (2% or more) higher than the engaged engine and a near zero torque indication. If a non-engagement occurs, smoothly close the throttle of the non-engaged engine and when stopped, shut down the engaged engine.

NOTE

If an abrupt ENG RPM (Nf) deceleration, jolt, or noise occurs during shutdown, do not attempt another start.

20. GEN — ON.

21. VOLTS DC — CHECK (27 - 28.5 vdc).

POST START CHECKLIST.

With both engines operating, maintain 85% ENG RPM (Nf) while completing the checklist.

1. SCAS POWER — POWER.
2. Attitude gyro — SET.
3. RADAR ALTITUDE altimeter — ON and SET.
4. IFF and radios — ON.
5. KY-28 — AS REQUIRED.
6. COMPASS — ALIGNED.
7. SCAS — CHECK NO-GO LIGHTS OUT. (Engage channels and check release in both cockpits.)
8. Throttles — SLOWLY FULL OPEN. CHECK THROTTLE DECALS ALIGNED.
9. RPM — 97 to 102 SET AT 100%.
10. ENG TRIM — SET.
11. Throttles — ENGINE IDLE — CHECK STOPS 62 ± 2%. NEW
12. ROTOR RPM AUDIO — CHECK.
13. Throttles — FULL OPEN.
14. ROTOR RPM — AUDIO.
15. ECU/VENT — AS DESIRED.

CAUTION

RAIN RMV system should be turned OFF as soon as cleared vision will permit. Heat may melt windshield if operated for a lengthy period on a dry windshield. NEW NEW

NOTE

A decrease in power available can be expected when operating the ECU and/or RAIN RMV.

PRE-TAKEOFF CHECKLIST.

1. RPM — 100%.
2. Caution and warning lights — CHECK.
3. TURRET STOW light — ON.
4. Instruments — CHECK PRESSURE AND TEMPERATURES.
5. FUEL QTY — CHECK.
6. SCAS — ENGAGED.
7. ECU — OFF or VENT/RAIN RMV — OFF.
8. Shoulder harness — LOCKED.
9. MASTER ARM — OFF.
10. Area — CLEAR.
11. Hover power — NOTE POWER REQUIRED.
12. Canopy jettison pins — OUT (after panel check and personnel are clear of helicopter).

AIR TAXIING.

Movement of the helicopter from one ground position to another can be accomplished by air taxiing at an altitude of 3 to 5 feet (skid tube to ground surface). From a hover, apply sufficient cyclic to establish a slow rate of movement over the ground in the desired direction. In confined areas, this rate of movement should be no faster than a man can walk.

Whenever possible, all air taxiing should be done by pointing the nose of the helicopter in the desired direction of movement. Sideward and rearward flight may be necessary for use in high winds and in confined areas. Due to increased rotor wash caused by air taxiing, caution should be exercised when in the vicinity of other aircraft due to rotor turbulence. Particular attention is directed to the increased rotor wash and its effects on loose objects and debris in the vicinity of the helicopter. Sufficient ground control personnel shall be available to provide for the safe taxiing of helicopters in the vicinity of obstructions or other aircraft. Only approved standard taxi signals will be used. Extreme caution should be exercised when taxiing at night.

TYPES OF TAKEOFF.

Because of the versatility of helicopters and their ability to takeoff from small areas, conditions at the time of takeoff are the governing factors in the type of takeoff to be accomplished. The factors governing the type of takeoff to be accomplished are the gross weight of the helicopter, the pressure altitude, outside air temperature, prevailing winds, the size of the takeoff area, and the tactical situation. There are many possible variations in takeoff procedures.

As the helicopter accelerates from hovering flight to flight in any direction, it passes through a translational period. If engine power, rpm, and collective are held constant in calm air, a momentary settling will be noted when the cyclic control is moved forward to obtain forward speed. This momentary settling condition is a result of the helicopter moving from the ground cushion and the tilting of the tip-path plane of rotation of the main rotor blades to obtain forward airspeed.

Wind velocity at the time of takeoff will partially eliminate this settling due to the increased airflow over the main rotor blades. As wind velocity increases this settling will be less pronounced.

Takeoff Performance.

A normal takeoff can be accomplished whenever the helicopter is capable of hovering with the skids 5 to 10 feet above the ground. The hovering charts in section XI can be used to determine if the helicopter can hover out-of-ground effect and in-ground effect.

Normal Takeoff to Hover.

The vertical takeoff is the normal type of takeoff, and should be used whenever possible. The helicopter is lifted from the ground vertically to a height of approximately 3 to 5 feet where the flight controls and engine may be checked for normal operation before continuing to climb. A normal vertical takeoff is made in the following manner: Increase throttle to full open with the collective pitch full down. Select desired rpm with the RPM switch. Place cyclic control in the neutral position. Increase collective pitch control slowly and smoothly until hovering altitude of 3 to 5 feet is reached. Apply pedals to maintain heading as collective is increased. Make minor corrections with cyclic to ensure vertical ascent, and use pedals to maintain heading.

Normal Takeoff From Hover.

Hover briefly to determine if engine and flight controls are operating properly. From a normal hover at 3 to 5 feet altitude, apply forward cyclic to accelerate into effective translational lift; maintain hovering altitude with collective and maintain heading with pedals, until translational lift is attained and the ascent has begun. Just prior to translational lift, the pilot will note a slight decrease in Ng. In order to preclude sinking, a slight increase in power may be necessary. As the aircraft is flown through translational lift (to preclude "ballooning"), a slight reduction in power may be necessary. Adjust power and smoothly lower the nose of the helicopter to arrive at approximately 25 feet of altitude and 50 knots of airspeed. Continue to accelerate and climb. Then smoothly lower nose of helicopter to an attitude that will result in an increase of airspeed to at least 70 knots. Adjust power as required to establish the desired rate of climb. Stabilize airspeeed and torque as soon as smooth rate of acceleration will permit.

NEW NEW NEW NEW

Normal Takeoff From The Ground.

This takeoff is utilized for expeditious departure or where normal takeoff to a hover is undesirable, example; heavy sand or loose grass. With the helicopter on the ground, coordinate increased collective with simultaneous forward cyclic to takeoff and move smoothly into translational lift. Maintain normal takeoff attitudes until translational lift is attained then proceed into normal climb.

Sliding Takeoff.

A sliding takeoff is made as follows: Apply power until the helicopter is light on the skids. Smoothly apply a slight amount of forward cyclic in order to begin a ground slide. Do not attempt to rush the forward motion of the helicopter as it will "dig in". As translational lift is gained, the helicopter will fly off in a near level attitude. Maintain this attitude until reaching 40 knots at which time a normal climb may be initiated.

Maximum Power Takeoff.

Place cyclic in neutral position. With throttles full open, increase collective smoothly. As the helicopter leaves the ground, continue increasing power to maximum available (not to exceed red line) and assume a 80 knot attitude. As power is increased, maintain heading by smoothly coordinating pedals. When sufficient altitude for obstacle clearance is attained, smoothly increase airspeed and reduce power to establish a normal climb.

Confined Area Takeoff.

This takeoff is utilized to depart an area over an obstacle where little or no forward motion is possible, until the helicopter is above the height of the obstacle. Lift into a four-foot hover if possible without exceeding limits. If within limits smoothly increase collective to maximum allowable power and lift straight up until skids are above obstacle height. Apply forward cyclic and accelerate into translational lift; then proceed into normal climb.

Crosswind Takeoff.

In the event a crosswind takeoff is required, there will be a definite tendency to drift downwind. This tendency can be corrected by applying the cyclic into the wind a sufficient amount to prevent downwind drift during takeoff. When a crosswind takeoff is accomplished, it is advisable to turn the helicopter into the wind for climb as soon as obstacles are cleared and terrain permits.

AFTER TAKEOFF.

After the helicopter accelerates forward to 10 to 15 KIAS, less power is required to sustain flight due to increase in aerodynamic efficiency as airspeed is increased to best climbing speed. Takeoff power should be maintained until a safe autorotative airspeed is attained, then power may be adjusted to establish the desired rate of climb.

CLIMB.

NEW

The normal climb is made by adjusting nose attitude to maintain at least 70 KIAS. Refer to section XI for optimum climb airspeeds. At approximately 100 feet prior to the desired cruising altitude, smoothly lower the nose, and allow the helicopter to accelerate to cruise airspeed, while maintaining a slight rate of climb to reach cruising altitude. As the airspeed approaches cruise airspeed, adjust power to maintain desired altitude and airspeed.

CRUISE.

Normal cruise will be conducted at a safe altitude and as dictated by weather, helicopter configuration and weight, terrain and obstacles, mission of flight, safety of the helicopter, and safety of persons and property on the ground. Refer to section XI for design cruise airspeeds and airspeed indicator corrections. Power and attitude should be adjusted to attain desired cruise airspeed.

DESCENT.

A descent is performed at a normal cruise airspeed and collective pitch control as required for desired rate of descent. At approximately 100 feet prior to desired cruising altitude, adjust nose attitude and power setting to level off at desired altitude.

PRE-LANDING CHECK.

1. RPM — 100%.
2. Caution and warning lights — CHECK.
3. TURRET STOW light — ON.
4. Instruments — CHECK PRESSURE AND TEMPERATURES.
5. FUEL QTY — CHECK.
6. SCAS — ENGAGED.
7. ECU — OFF or VENT/RAIN RMV — OFF.

8. Shoulder harness — LOCKED.

9. MASTER ARM — OFF.

NEW 10. Landing light — AS REQUIRED.

LANDING.

Normal Approach and Landing.

NEW The downwind leg should be flown at 80 KIAS, 500 feet above the surface. Select the 180 degree position with reference to the existing wind. At the 180 degree position commence a coordinated descending turn, to arrive at the 90 degree position NEW at 300 feet and 70 KIAS. Adjust the rate of turn and rate of descent so as to intercept the landing line with 1,000 feet of straightaway and about 125 feet of altitude. At this point adjust nose altitude smoothly to slow the airspeed and decrease the rate of descent. Start the gas producer accelerating by slightly increasing collective while the helicopter is still in translational lift. Maintain heading with pedals. The objective of a normal approach is to simultaneously arrive over the point of intended landing with zero ground speed and approximately 3 to 5 feet of altitude. This should be accomplished without an extreme flare and/or abrupt power change.

Once the helicopter is established in a hover, lower the collective to establish a slow, controlled rate of descent to a gentle touchdown, making corrections with pedals and cyclic to maintain a level attitude, vertical descent, and constant heading. Upon contact with the ground, continue to lower collective smoothly and steadily until the entire weight of the helicopter is resting on the ground and the collective is full down.

Slope Landing.

Make the slope landing by heading the helicopter generally cross-slope. (Slope landing should be made cross-slope with skid type gear.) Descend slowly, placing the upslope skid on the ground first. Coordinate reduction of collective pitch with lateral cyclic (into the slope) until the downslope skid touches the ground. Continue coordinating reduction of collective and application of cyclic into the slope until all the weight of the helicopter is resting firmly on the slope. If the cyclic control contacts the stop before the downslope skid is resting firmly on the ground, return to hover, and select a position where the degree of slope is not so great. After completion of a slope landing, and after determining that the helicopter will maintain its position on the slope, place the cyclic in neutral position.

WARNING

After upslope skid contacts deck, a roll rate must be established for the downslope skid to contact the deck. Angular momentum can build to the point where dynamic rollover can ensue regardless of helicopter angle of bank. If mast bumping occurs, reposition cyclic to stop bumping and re-establish hover.

CAUTION

If mast bumping occurs, reposition cyclic toward center, keep control inputs and aircraft roll rate small to avoid dynamic rollover, then re-establish hover.

Crosswind Landing.

Crosswind landings can generally be avoided in helicopter operations. Occasionally, plowed, furrowed or eroded fields, and narrow mountain ridges may require that crosswind landings be made. The crosswind landing in such instances is utilized to prevent landing at a high tipping angle or dangerous tail low attitude.

Crosswind landing may also be accomplished on smooth terrain when deemed advisable by the pilot. The following procedures should be observed in accomplishing crosswind landing:

1. ENG RPM (Nf) 100 percent.
2. Hover helicopter crosswind.
3. Hold the cyclic control stick into the wind to prevent side drift throughout the landing.
4. Proceed as in normal landing.

Steep Approach and Landing.

The steep approach procedure is a precision, power-controlled approach used to clear obstacles

and to accomplish a landing in confined areas. Slightly past the normal 180 degree position, commence a coordinated descending turn to arrive at the 90 degree position with 300 feet and 70 knots. Continue to decelerate and turn to arrive on the wind line with approximately 1000 feet of straightaway and 300 feet above the ground or 100 feet of altitude above the highest obstacle. Airspeed should be smoothly reduced to 45 KIAS as the approach angle is reached. Reduce collective and adjust cyclic to commence a descent on the desired approach angle. Keep the point of intended landing in sight through the windshield. The airspeed is controlled by nose attitude and the rate of descent is controlled by the collective. Power requirements are governed by the gross weight, wind velocity, density altitude, and approach angle. Commence gas producer acceleration and slow the rate of descent with collective, simultaneously reducing airspeed with cyclic so as to arrive over the point of intended landing with 3 to 5 feet of altitude and zero airspeed. This should be effected with little or no flare. The landing from a hover is standard.

NEW NEW

WARNING

During steep approaches at less than 40 knots, avoid descent rates exceeding 800 FPM. See power settling paragraph in Section 4.

High Speed Approach and Landing.

The high speed approach is employed to accelerate the transition from flight to landing. Airspeed is maintained in excess of 100 KIAS to an altitude of 100 feet, at which point the quick stop technique is employed to transition to a landing. Rotor rpm will tend to overspeed during the approach and quick stop. Adjust collective and throttle as necessary to maintain rotor/engine rpm within limits. Return of throttle to the governor range must be effected early enough to permit the engine to accelerate, so as to arrive at 45 KIAS, level attitude in order to transition from a steep approach to a landing.

CAUTION

Rapid application of throttle at or near flat pitch can result in a rotor or engine overspeed and subsequent damage.

Maximum Gross Weight Landing (No Hover Landing).

Maximum gross weight landings should be practiced to simulate landing without hovering at high gross weights and high density altitudes. This type of landing may be employed where a transition to a hover is not possible or a sliding landing is not feasible. The helicopter is flown as in a normal approach with the exception that a straightaway of 1000 feet, 70 KIAS, and 125 feet of altitude are desirable. At this point raise the nose attitude to slow airspeed and adjust collective to slow the rate of descent. As the airspeed decreases, continue to adjust collective to maintain a slow, controlled rate of descent. As translational lift is lost, level the helicopter and assume the landing attitude. Continue to increase collective to maximum power available to prevent a hard landing. Touchdown should be at less than 5 knots ground speed. Once the helicopter is firmly on the ground, smoothly lower the collective to the bottom to complete the landing. No hover landings should be made, whenever possible, when operating in sandy or dusty areas to minimize wear on engine and rotor blades.

Sliding Landing.

Sliding landings should be practiced to simulate conditions where hovering in ground effect is not possible. They also aid the pilot in assessing the feasibility of an operation requiring maximum helicopter performance. They have value in that they acquaint the pilot with the characteristics of skid-type landing gear on various landing surfaces and they afford the opportunity to evaluate possible landing sites in case of engine failure. If an emergency autorotative approach is necessary, a sliding landing has the advantage of greater helicopter controllability during touchdown. It affords a safer landing with heavy gross weights as well.

To practice sliding landing, select a firm, smooth surface of sufficient length and free of obstructions. The helicopter is flown as in normal approach until just prior to touchdown. Maintain sufficient forward speed to retain translational lift and smoothly and slowly lower the helicopter to the ground with the collective. Maintain heading with pedals. Do not land the helicopter in a crab. Compensate for any crosswind with the "wing down" method. Landing attitude should be skid level to prevent any pitching of the helicopter at touchdown. Do not lower collective abruptly during slide. Once the helicopter is on the ground, allow the helicopter to slide to a gradual stop. When the helicopter has stopped, lower collective to the bottom.

WARNING

Sliding landings on soft surface such as mud, loose sand, and plowed fields may cause the skids to dig in. This could result in an abrupt stopping of the helicopter, possibly causing severe structural damage or a nose-over crash.

AUTOROTATION PRACTICE.

Full autorotation landings shall not be attempted as a practice measure except by pilots specifically authorized by competent authority. Practice autorotations with power recoveries are permitted; however, recovery will be initiated with sufficient altitude to permit full recovery at an altitude of 3 to 5 feet above the surface. From this point a waveoff may be accomplished straight ahead as in a normal takeoff.

Practice autorotations will always be made into the wind and will be performed at approved landing areas or airfields. Always plan an autorotation to an area that will permit a safe landing in an actual emergency, preferably a hard, flat smooth surface, clear of approach and roll-out obstructions. Practice autorotations should not be attempted in conditions of critical center of gravity loadings. Caution should be exercised when practicing autorotations under conditions of high gross weight because angle of descent is steeper, and rotor rpm has a tendency to build up and is harder to control. For practice autorotations, the minimum entry altitude should be 500 feet above the ground and not less than 70 KIAS for straight in autorotations. The minimum entry altitudes will be 750 feet AGL for 90 degree autorotations and 1000 feet AGL for 180 degree autorotations. To initiate the maneuver, reduce collective to the full down position, simultaneously rolling off the throttles to the engine idle detent. Check Ng at flight idle and maintain heading and/or balanced flight with pedals. During advanced phases of training, deviation from minimum altitude and speed will be at pilot's discretion but not less than 100 feet and 70 KIAS.

NOTE

If the helicopter is only slightly out of balanced flight, the rate of descent will be increased by about 500 feet per minute. An acute unbalanced condition can result in an extremely high rate of descent.

Adjust collective as necessary to maintain rotor/engine rpm within limits.

Basic autorotation descents are performed at a constant 80 KIAS and in balanced flight. At approximately 75 to 100 feet above the ground, commence a smooth flare, sufficient to slow the airspeed and rate of descent. The rate and degree of flare necessary will vary with airspeed, gross weight, height above the ground, wind conditions, and desired ground speed for landing. Adjust the collective as necessary to keep rpm within limits. Roll throttles open enought to join ENG RPM (Nf) needles with ROTOR RPM (Nr) needle at 100 percent and increase collective slightly. Check GAS PRODs to ensure that gas producers are accelerating normally. Approaching the apex of the flare, smoothly roll both throttles to the full OPEN position. When the ground speed has been slowed to a safe sliding landing speed, smoothly and positively lower the nose of the aircraft to achieve a skids level attitude by 20 feet. At approximately 15 feet of altitude, smoothly increase collective and throttle to stop the descent at 3 to 5 feet above the ground while maintaining 100 percent ROTOR RPM (Nr) ENG RPM (Nf). Practice autorotations may be terminated to a hover or with forward ground speed below 15 knots.

WARNING

An excessive nose high attitude in the flare at too low an altitude will result in dragging the tail skid. This can cause serious structural damage to the tail pylon, possible tail rotor failure, and uncontrolled flight.

At average gross weights, best glide speed is approximately 110 KIAS and minimum rate of descent speed is approximately 65 KIAS. Skidding/slipping the helicopter or reducing airspeed will increase the rate of descent and prevent over-shooting. However, it is important that the helicopter be returned to balanced flight prior to commencing the recovery (flare).

HOVERING AUTOROTATION.

From a normal hover (not more than 5 feet), roll off the throttles to flight idle, taking care not to raise or lower the collective inadvertently. Use sufficient right directional control pedal and right cyclic to maintain heading and ensure a vertical descent. The helicopter will tend to maintain altitude momentarily, then will commence to settle. As it settles, apply up collective to cushion the landing. After the helicopter is firmly on the deck, lower the collective to the full down position and smoothly roll the throttles on to full open.

CAUTION

Hovering autorotations should only be practiced at a moderate gross weight. At heavy weights, greater skill and training are required to cushion the landing and there is a greater possibility of structural damage to the helicopter.

DUAL ENGINE FAILURE (SIMULATED).

Simulated dual engine failures may be performed in daylight, night, and under hooded instrument conditions. They shall also be practiced over suitable terrain for the purpose of developing sound pilot judgement in the selection of the best available emergency landing site. Wind direction, air start procedures, and Mayday calls should also be considered. Deviations from straight-in autorotations and varying entry airspeeds should be practiced to ensure full utilization of the helicopter's capabilities and additional pilot training. Simulated dual engine failures shall be terminated no lower than 200 feet AGL and not less than 60 KIAS.

CAUTION

During simulated dual engine failures initiated above 120 knots, if an aft cyclic input is not made, a SCAS nose-down pitch correction combined with rapid decrease of collective could cause less than +0.5 G loading which may result in excessive main rotor flapping and possible mast bumping.

QUICK STOP.

The quick stop is a maneuver used to reduce airspeed as rapidly as safely feasible. It is useful in aborting takeoffs, avoiding other aircraft or transitioning from flight to an immediate landing attitude. Execute a normal takeoff and accelerate into forward flight. Establish stable 100 KIAS flight at a constant altitude of 100 feet. For the quick stop reduce collective and apply coordinated aft cyclic to slow airspeed while maintaining constant attitude (do not flare so abruptly that the helicopter balloons). Adjust collective and throttle as necessary to maintain rotor limits. When airspeed has slowed to 45 KIAS, level the helicopter and smoothly transition from a steep approach to landing.

CAUTION

Reducing collective rapidly and applying aft cyclic can result in rotor overspeed.

TWENTY AND THIRTY DEGREE DIVES.

Twenty and thirty degree dives are practiced to simulate high level rocket attack and to acquaint the pilot with ordnance delivery maneuvers. These dives should be initiated at or above 2000' AGL to have ample time and altitude for a smooth pulloff. Set 40% torque and raise the nose 20 degrees above the horizon. Slow to approximately 60 knots and smoothly roll the aircraft toward the target line while maintaining the nose on the horizon. Fifteen degrees prior to intercepting the target line, begin to roll wings level and allow the nose of the aircraft to fall below the horizon. Stabilize on the target line at the desired dive angle while maintaining balanced flight and 40% torque. To avoid weapons fragmentation, recover prior to 1000' AGL by

raising the nose and then rolling the aircraft away from the gun target line while simultaneously increasing collective.

PRACTICE HIGH SPEED LOW LEVEL AUTOROTATIONS.

The practice high speed low level autorotation is a maneuver used to simulate dual engine failure at low level. To perform the maneuver, establish 100-140 KIAS at a constant altitude not less than 100 feet AGL or 50 feet above the highest approach obstacle. To enter the autorotation, reduce the throttle to flight idle and apply coordinated aft cyclic with collective reduction to slow the aircraft and to maintain Nf/Nr within limits. At 80 KIAS and 75 feet AGL, complete a normal autorotational approach.

CAUTION

During practice autorotations initiated above 120 knots, if an aft cyclic input is not made, a SCAS nose-down pitch correction combined with rapid decrease of collective could cause less than +0.5 G loading which may result in excessive main rotor flapping and possible mast bumping.

SINGLE ENGINE FAILURE (SIMULATED).

This maneuver will be performed in the training environment to simulate a single engine emergency. Simulated single engine failures shall be practiced only when single engine flight, landing, or recovery by autorotation is possible in the event of dual engine power loss. Fly the landing pattern to arrive at 500' AGL and 80 knots at the abeam position. Commence a coordinated descending turn to arrive at the 90 degree position at 300' AGL and 70 knots. Continue to decelerate and turn to arrive on the wind line with a shallow glide slope. Slow the aircraft while continuing descent to arrive at the landing site. Procedural steps should conform to single engine emergency procedures as stated in Section V with simulation of appropriate steps (2, 6, 7, 8, 9, 11). Single engine waveoffs may be initiated as judgement dictates but should not be attempted below 75' AGL or 45 knots.

CAUTION

It is important to closely monitor the ITT and Ng of the good engine to preclude engine damage.

NOTE

Intentional single engine takeoffs are prohibited.

MANUAL FUEL FLIGHT.

Manual fuel flight should be practiced to simulate governor or automatic fuel control malfunctions and to acquaint the pilot with the flight characteristics of the helicopter when operated in the manual fuel mode. The maneuver will be initiated by rolling both throttles to flight idle while on the deck. The engine with the simulated malfunction should then be switched to the manual mode. Proper fuel control switchover should be verified by a corresponding advisory panel indication and slight Ng fluctuation. A "pop" which is caused by a slight compressor stall may be heard when switching into manual fuel. While maintaining the throttle for the engine in manual fuel at flight idle, increase the other throttle to full open. Increase the throttle in manual fuel slowly to allow engagement of Nf and adjustment of engine torque. The recommended technique for this maneuver is to maintain the manual fuel torque needle at the bottom of the transmission torque triangle. To ensure that engine limits are not exceeded, make all power changes slowly and smoothly during manual fuel flight. To complete the maneuver, land the aircraft and roll both throttles to flight idle. Switch the engine, which is in manual fuel, back to auto and verify the proper advisory panel indication and Ng fluctuation. Slowly increase both throttles to full open.

CAUTION

- The Nf and AFCU overspeed governors are not functional for the engine operated in the manual fuel mode.
- In the event of an intermittent or sustained electrical failure, the fuel control will automatically revert to the automatic mode. Should electrical failure occur, place all governor control switches in the automatic position immediately.

TAIL ROTOR MALFUNCTION (SIMULATED).

The simulated tail rotor malfunction maneuver is practiced to simulate landing with a fixed pitch on the tail rotor. Once established at pattern altitude, the pilot not actually flying the maneuver will hold the pedals in a fixed position (the pilot in control does not remove his feet from the pedals). The aircraft will react to control inputs in the following manner:

Collective increase — yaw right
Collective decrease — yaw left
Throttle increase — yaw right
Throttle decrease — yaw left
Airspeed increase — yaw left
Airspeed decrease — yaw right

The pilot may adjust collective, throttle, and airspeed to become familiar with the aircraft reaction to each adjustment and to determine how these responses may be used on final approach to effect a landing. When possible, turns should be made in the direction of the yaw. The approach should be flown with a slightly wider abeam position, on a shallow glide slope, and with no rapid power applications. Minimum control movements should be made on final. On short final, adjust the collective and airspeed as necessary to align the aircraft with the left side of the runway. Continue a low approach to simulate a sliding landing at not less than 3 feet AGL. A small throttle reduction may be used to yaw the nose to the left for final heading correction prior to a simulated touchdown. At no time will throttles be reduced below activation of the rpm audio warning signal (in no case less than 92%). Waveoff should be executed in balanced flight at 100% Nr.

DUAL HYDRAULIC FAILURE (SIMULATED).

Dual hydraulic system failure (simulated) is a maneuver practiced to enable the pilot to land the helicopter in the event of a dual hydraulics system failure. All approaches will be made to a simulated sliding landing (low approach) at no less than 3 feet AGL and not less than 20 knots airspeed. On the downwind leg at 500 feet and 80 knots, set 30% torque, turn off the No. 1 hydraulics system and disengage the SCAS. Reset the Master Caution light and check the No. 1 hydraulics gage for a zero psi reading. 30% torque (with throttles full open) is the minimum torque allowable by collective application, however, torque may be increased up to 50% during the approach if necessary. Extend the downwind to establish a straight in approach of at least 2 NM. The abeam position should be wider to allow for a shallow turn. Throttles may be reduced to assist in establishing a descent, but Nr must be maintained at or above the limit for the rpm audio warning signal (in no case less than 92%). Maneuver the aircraft as necessary to establish a rate of descent. At light gross weight configurations, the minimum power setting (30% torque) may not result in a rate of descent unless the airspeed is reduced to below 35 knots. Airspeed should not be reduced below 20 knots. Ensure that both throttles are full open and the aircraft is aligned with runway heading prior to commencing the simulated slide on landing. The maneuver is terminated at no less than 3 feet AGL and on the waveoff full systems will be restored prior to turning downwind.

WAVEOFF.

Power-On Approach.

1. Collective — SMOOTHLY INCREASE TO TAKEOFF POWER.
2. Airspeed — INCREASE TO CLIMB AIRSPEED.
3. Cyclic — ESTABLISH A CLIMB.

Autorotative Approach.

1. Throttles — INCREASE TO FULL OPEN. (Coordinate with collective to prevent overspeed.)
2. Collective — SMOOTHLY INCREASE TO TAKEOFF POWER.
3. Airspeed — INCREASE TO CLIMB AIRSPEED.
4. Cyclic — ESTABLISH A CLIMB.

SHUTDOWN.

WARNING

Pilots shall ascertain, prior to shutdown, that the area is clear and that personnel around the helicopter are outside the tip path of the main rotor. During any operations, the pilot is responsible for keeping personnel around the helicopter to a minimum number for safe operations.

1. Collective — DOWN.
2. Controls — CENTERED.
3. Canopy jettison pins — IN.
4. Throttles — ENGINE IDLE (61 ± 1%) FOR 1 MINUTE.
5. FORCE TRIM — ON.
6. ROTOR RPM AUDIO — OFF.
7. RADAR ALTITUDE altimeter — OFF.
8. KY-28 — OFF.
9. Radios and navigation equipment — OFF.
10. Countermeasures equipment — OFF.
11. ECU/VENT — OFF.
12. IDLE STOP — AFTER ONE MINUTE REL — BOTH ENGINES.

Momentary actuation of the IDLE STOP REL will result in the solenoid remaining retracted for a period of five seconds. Thus the throttle may be closed to the off position anytime within five seconds after the switch is momentarily actuated.

13. Throttles — CLOSE.
14. SCAS POWER — OFF.
15. INVERTERS — OFF.
16. NO. 1 GEN, NO. 2 GEN — OFF.
17. Fuel — OFF (at zero percent).

CAUTION

- Without the use of rotor brake on shutdown, winds of approximately 35 knots or above may cause the rotor to windmill indefinitely (e.g., 20% ROTOR RPM (Nr).

- If severe main rotor flapping or mast bumping occurs due to high/gusty winds, apply cyclic into wind, as required to prevent or eliminate mast bumping.

18. Rotor brake — ENGAGE BETWEEN 60-25% Nr.

NOTE

If rotor brake chatter or loud ticking noise occurs, notify maintenance.

19. Lights — OFF.
20. BATTERY — OFF.
21. Collective strap — SECURE.

POSTFLIGHT EXTERNAL INSPECTION.

A postflight inpection should be made by the pilot upon leaving the helicopter after completing the assigned mission. This inspection is a general visual inspection of the landing skids, fuselage, tail rotor and drive systems, tail assembly and engine compartment. In addition to the established requirements for reporting any systems defects, the pilot will also make entries on the yellow sheet to indicate when any normal operating limits contained in this manual have been exceeded. When an emergency fuel is used, report the type fuel and length of operation.

NOTE

Any contact with salt water spray shall be noted on the VIDS/MAF.

NIGHT FLYING.

The procedures for night flying will be essentially the same as those for days; however, visual reference and depth perception are reduced.

Restrictions on Night Flying.

Helicopters shall not be flown at night if any of the following equipment is not in operating condition.

CAUTION

When landing in grass area, turn searchlight OFF after landing to prevent fire hazard.

1. Pilot compartment instrument and console lights.
2. All exterior lights.
3. UHF radio.
4. Pilot gyro horizon.
5. Radar altimeter.

Helicopters shall not be flown beyond the immediate vicinity of the field unless under positive control of the tower if any of the following equipment is not in operating condition:

1. Radio direction finding and navigation equipment.
2. Compass gyrosyn.

PART 3 — SHIP BASED PROCEDURES

COMMAND RESPONSIBILITY.

Shipboard environment, procedures, and operations must be as normal as those used ashore. The squadron is no longer an independent command when embarked aboard ship but has become an integrated part of an operating system. Marine squadrons embarked for amphibious operations are component parts of the landing force under the command of the Landing Force Commander. The Amphibious Task Force Commander exercises his command authority of these units through the Landing Force Commander. All squadrons embarked become a part of the overall ships function for coordination, control, and support. The commanding officer of the squadron is responsible at all times for the combat readiness of his organization. Command relations and general procedures are contained in NWP 42 and NWP 22-3.

FIELD CARRIER LANDING PRACTICE.

Field carrier landing practice (FCLP) is required of all pilots within 30 days prior to carrier qualification to ensure maximum crew

proficiency. The number of periods will depend on the experience and ability of the individual pilot, however, a minimum of two FCLP periods are required (one day and one night period) FCLP's will be conducted to simulate shipboard operations as closely as possible.

BRIEFING PRIOR TO FCLP.

1. Patterns, altitudes, and airspeeds.
2. Helicopter director signals.

Night FCLP.

When facilities permit, pilots should complete FCLP's prior to night carrier qualification to familiarize themselves with night shipboard landing procedures.

CARRIER QUALIFICATION.

The term carrier qualification referred to herein encompasses all shipboard landing operations. Initial day/night carrier qualification should be made under ideal weather conditions including a visible horizon.

Carrier Qualification And Requalification Requirements.

Nothing in this manual precludes the commanding officer from exercising his own judgment concerning the ability of a pilot to perform a mission involving recovery on board or when operational necessity dictates.

CARRIER QUALIFICATION REQUIREMENTS.

1. Day initial qualification: No less than 5 landings and takeoffs.
2. Night initial qualification: Day qualified and not less than 5 night landings and takeoffs. At least 2 day landings must be made on the day of night qualification.

REQUALIFICATION REQUIREMENTS.

1. Day: Not less than 2 landings.
2. Night: Not less than 3 landings and at least 2 day carrier landings must be made on the day of night qualification.
3. Currency: Requalify every 12 months. NEW
4. If pilot has not met the requirements for requalification in a 12 month period, subject pilot is no longer current and must meet initial qualification requirements. NEW

LANDING AND RECOVERY PROCEDURES.

Shipboard qualifications are conducted using the same procedures contained in the launch and recovery operations in this section.

Flight Scheduling.

Refer to NWP 42.

Briefing.

All pilots will receive a thorough briefing by the ship's Air Department Officer or his representative on the ship's air operations and procedures. Flight briefings will be conducted by the unit's Operation Department prior to each flight. This detailed briefing will include the information set forth in this section, and shall include the following:

1. LSE.
2. Wind direction and velocity for flight operations.
3. Use of helicopter lights (if night operation).
4. Traffic patterns and altitudes about ship.
5. CCA recovery and/or scheduled recovery time.
6. Special safety precautions during shipboard operation.
7. Ship's point of intended movement and nearest land.
8. Aircraft deck spotting.
9. Ship's navigational aids.

10. Weather forecast and weather over nearest land.

11. Ship's position in the Force.

Hanger and Flight Deck Procedures.

NEW Deck procedures are found in CV NATOPS manual, NWP 42 and NWP 50-2.

OPERATION OF EQUIPMENT.

Only qualified personnel shall operate towing equipment. Towing couplings shall be inspected prior to towing. Only approved tow bars will be used. Ground handling wheels shall be installed in eye bolts provided on each landing gear skid tube, located forward of aft cross tube and forward of the forward cross tube. Reference maintenance manual for proper ground handling gear installation and operation.

WARNING

Care shall be taken to ensure that the ground handling pins are properly installed into eyebolts on the skid tube.

Ground Handling Gear Types.

Two types of ground handling gear can be used for moving the helicopter, forward mounted and aft mounted.

AFT GROUND HANDLING GEAR.

NEW At gross weights of 13,560 pounds or less, the aft ground handling gear may be used for moving the helicopter. While in movement each wheel assembly should be manned by a qualified aircraft handler. A qualified aircraft handler shall be positioned on the tail skid to take the weight off the front of the skid tube and to provide steerage. Two aircraft handlers may be utilized on the tail skid when wind/weight conditions warrant. The helicopter may be towed or pushed by hand if a sufficient number of aircraft handlers are available. Care should be exercised when lowering the helicopter onto the deck. The helicopter should be lowered slowly, and after assuring all personnel are well clear of the helicopter.

FORWARD MOUNTED GROUND HANDLING GEAR.

The forward ground handling gear should be used when helicopter is at a high gross weight and/or forward cg.

PROPER OPERATION WHEN FORWARD MOUNTED GROUND HANDLING GEAR IS USED.

Install all ground handling gears in eyebolts on skid tube. Extend aft ground handling wheel on one side only. Extend forward ground handling gear on the same side. Extend remaining aft ground handling gear. Extend remaining forward mounted ground handling gear. For lowering reverse the procedure.

WARNING

Do not raise or lower forward mounted ground handling gear unless the aft ground handling gear is raised.

NEW During actual movement of the helicopter each hand brake shall be manned by a qualified aircraft handler. Hand brakes on ground handling wheels shall be applied immediately upon whistle or hand signal.

A qualified aircraft handler shall be positioned on the tail skid to provide steerage. The helicopter may be towed or pushed by hand. Care should be exercised when lowering the helicopter onto the skids. The helicopter should be lowered slowly and after assuring all personnel are well clear of the helicopter.

FLIGHT DECK OPERATIONS.

1. Flight deck handling procedures and aircraft handling signals are contained in NWP 42 and NWP 50-2.

2. Personnel not required for plane handling will remain clear of the flight deck during launch and recovery of helicopters.

3. Starting engine and rotor shall be done only upon direction of personnel from the ship's Air Department.

4. Air taxiing and movement of helicopters shall be under the positive control of LSEs.

Manning Helicopters.

Upon receipt of the word to MAN AIRCRAFT, flight crews will expedite movement to the helicopter and complete the preflight inspection and man aircraft.

Starting Engines and Rotor.

Preparations for starting the engine and rotor shall be completed by the helicopter crew immediately after they enter the helicopter.

Auxiliary power should be plugged in; the prestart check list completed; inverter, UHF radio, TACAN radio, FM radio and automatic direction finder on for warmup, and a visual check of the surrounding deck area should be made.

CAUTION

NEW Monitor voltage supplied by auxiliary power at 26 to 29 vdc.

Mandatory requirements for starting engine and rotor consists of the following items:

1. Main rotor and tail rotor blade tiedowns shall be removed.
2. Offset main rotor blade to prevent tailboom strike.
3. Deck tiedown secure.
4. Flight deck area clear of unnecessary personnel.
5. NEW Rotor engage/disengage wind limits (see figure 3-3).
6. Fire guard on station.

NEW Engines shall be started only on signal from a LSE and under positive control of PRI-FLY. Start procedure is normal. It may be necessary for the pilot to adjust tip path plane. Cockpit checks are accomplished in the normal sequence but should be made as expeditiously as possible consistent with safety.

WARNING

Flight control checks, if necessary, shall be performed with an absolute minimum of flight control displacement. When the helicopter is operating at 100 percent ENG RPM (Nf), a moderate amount of right directional control pedals shall be applied when the collective pitch control is full down to prevent the helicopter from skidding on the flight deck.

Tiedowns shall be removed when the pilot signifies that he is ready for launch and the LSE has received permission to launch from PRI-FLY. The pilot will ensure complete removal of tiedown chains prior to takeoff. In case of downed helicopter, tiedown chains shall be left on, and disposition of the helicopter will be determined immediately after the launch. All flight deck operations, including starting engine and rotors, removing tiedown chains, etc., are executed on signals relayed from PRI-FLY. The pilot should keep the LSE in sight and be prepared to receive signals at any time. NEW NEW

Launch and Recovery Operations.

All commands are given by Primary Flight Control. LSEs relay all signals given by PRI-FLY when aircraft is in close proximity to flight deck. NEW

RELATIVE WIND FOR LAUNCH AND RECOVERY.

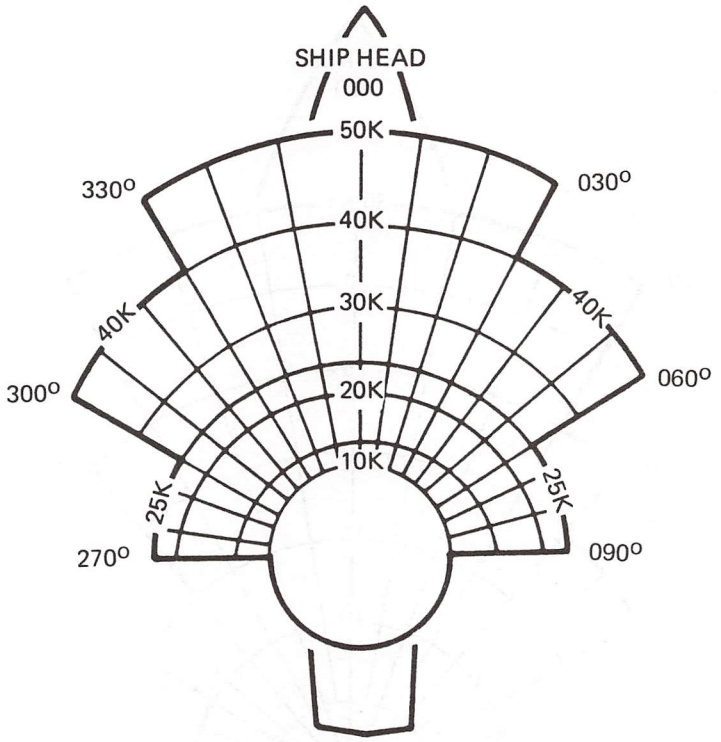
1. For launch and recovery wind limits, see figure 3-4. In an emergency, the helicopter may be launched in 60 knot relative winds. NEW
2. Operations in the island wash area should be held to a minimum.

LAUNCH PROCEDURES.

1. Helicopter shall not takeoff until cleared by PRI-FLY and a signal has been received from the LSE. NEW
2. Helicopters shall take maximum advantage of available deck while gaining transitional lift.

AH-1T (Tow and Non-Tow) ROTOR ENGAGEMENT/DISENGAGEMENT WIND LIMITATIONS

HELICOPTER ALIGNED WITH SHIP'S CENTERLINE



FUNCTIONAL ROTOR BRAKE

LPH SPOTS 1-5

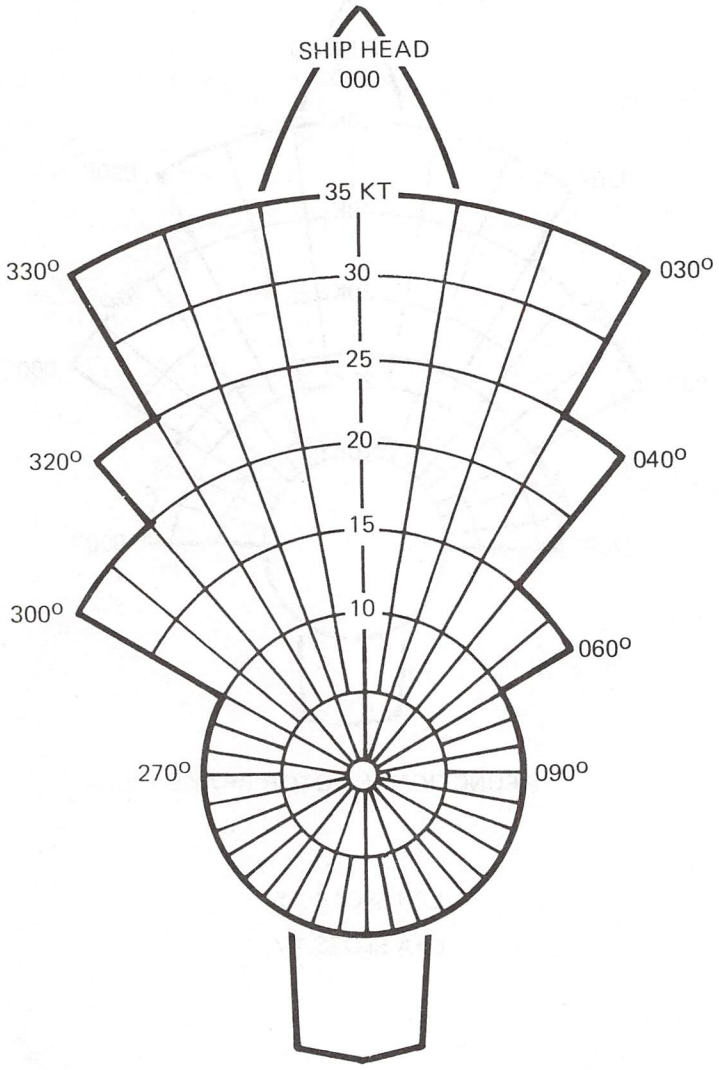
LHA SPOTS 1-7

Figure 3-3. Wind Limitations

AH-1T (Tow and Non-Tow)

NO ROTOR BRAKE ENGAGE/DISENGAGE WIND ENVELOPE

HELICOPTER ALIGNED WITH SHIPS CENTERLINE

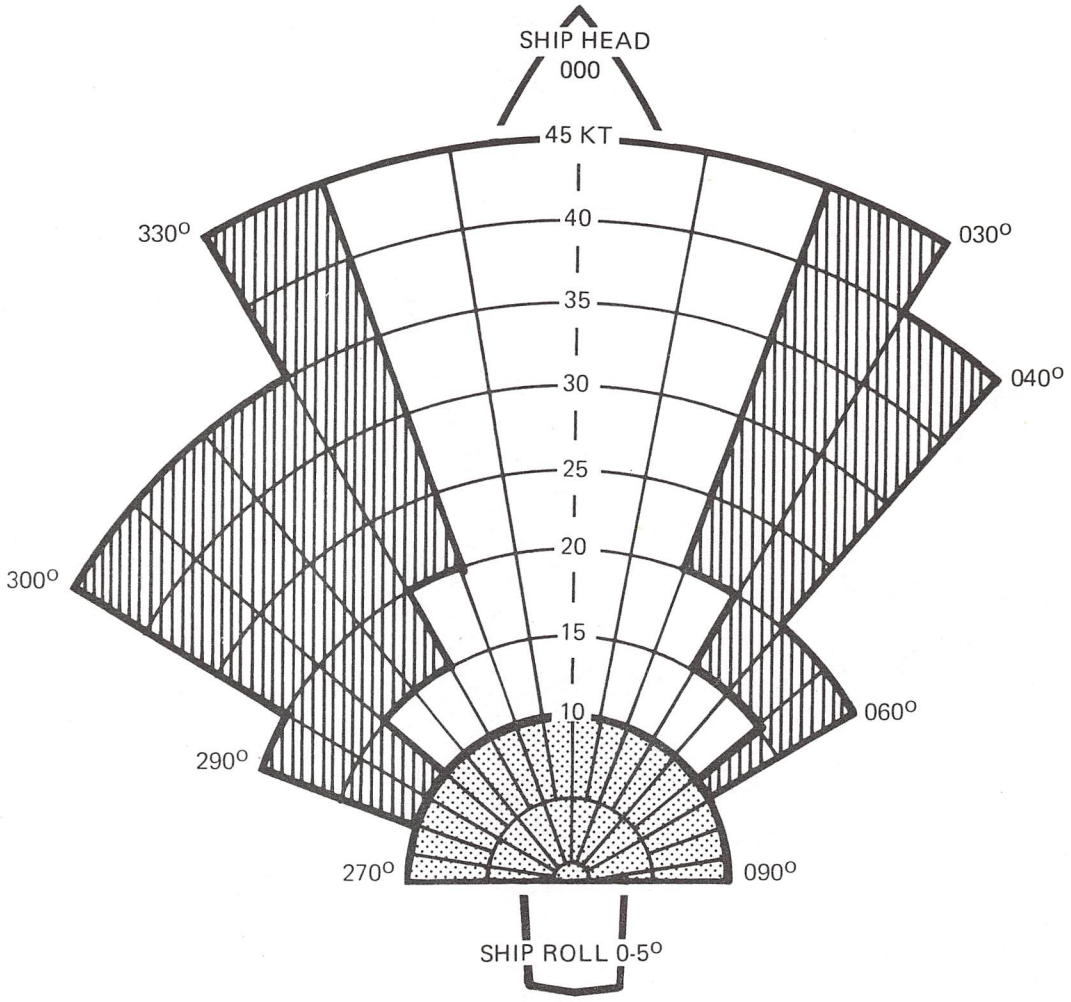


LHA SPOTS 2-5
LPH SPOTS 2,3,4
SHIP ROLL 0-5°

Figure 3-4. Wind Envelope (Sheet 1 of 4)

AH-1T (Tow and Non-Tow)
DAY LAUNCH/RECOVERY WIND ENVELOPE

HELICOPTER ALIGNED WITH SHIPS CENTERLINE



LHA SPOTS 1-6
LPH SPOTS 1-4

FLIGHT OPERATIONS IN THIS AREA MAY REQUIRE LARGE, RAPID YAW AND ROLL CONTROL INPUTS. APPROACHES, LANDING AND TAKEOFFS SHOULD BE SLOW AND PRECISE.

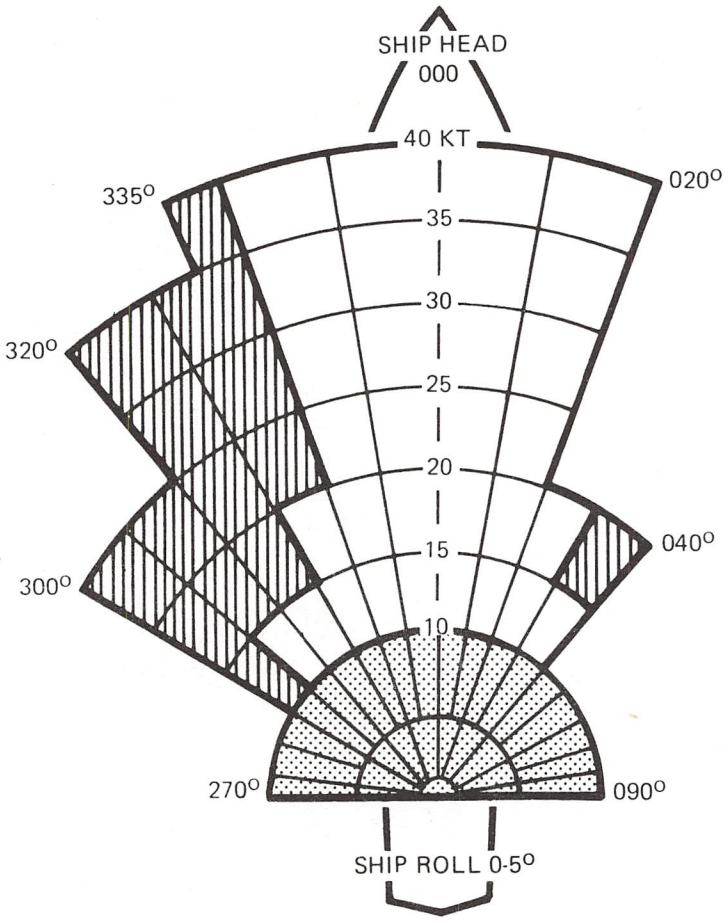
FLIGHT OPERATIONS IN THIS AREA ARE CHARACTERIZED BY LARGE POWER CHANGES AT THE DECK EDGE. THE PILOT SHOULD ENSURE THAT THERE IS SUFFICIENT POWER AVAILABLE FOR A NO WIND OGE HOVER IN THE EXISTING AMBIENT CONDITIONS PRIOR TO A TAKEOFF OR LANDING.

Figure 3-4. Wind Envelope (Sheet 2 of 4)

AH-1T (Tow and Non-Tow)

NIGHT LAUNCH/RECOVERY WIND ENVELOPE

HELICOPTER ALIGNED WITH SHIPS CENTERLINE



LHA SPOTS 4-7
LPH SPOTS 3,4,5

GSI ON OR OFF

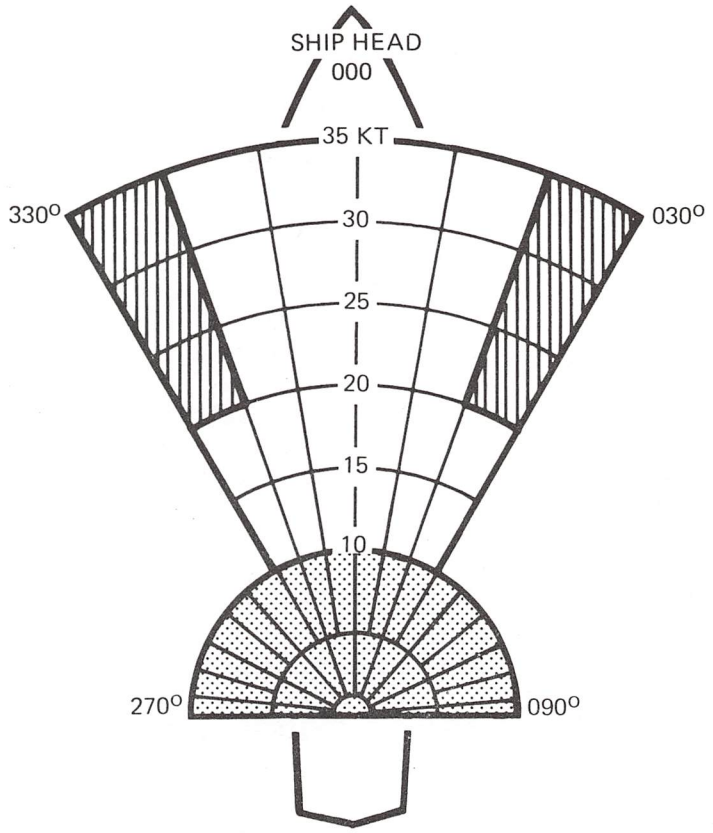
FLIGHT OPERATIONS IN THIS AREA MAY REQUIRE LARGE, RAPID YAW AND ROLL CONTROL INPUTS. APPROACHES, LANDING AND TAKEOFFS SHOULD BE SLOW AND PRECISE.

FLIGHT OPERATIONS IN THIS AREA ARE CHARACTERIZED BY LARGE POWER CHANGES AT THE DECK EDGE. THE PILOT SHOULD ENSURE THAT THERE IS SUFFICIENT POWER AVAILABLE FOR A NO WIND OGE HOVER IN THE EXISTING AMBIENT CONDITIONS PRIOR TO A TAKEOFF OR LANDING.

Figure 3-4. Wind Envelope (Sheet 3 of 4)

AH-1T (Tow and Non-Tow)
Days SCAS OFF Recovery Wind Envelope

HELICOPTER ALIGNED WITH SHIPS CENTERLINE



SHIP ROLL 0-5°
LHA SPOTS 4-7
LPH SPOTS 3, 4, 5

FLIGHT OPERATIONS IN THIS AREA MAY REQUIRE LARGE, RAPID YAW AND ROLL CONTROL INPUTS. APPROACHES, LANDING AND TAKEOFFS SHOULD BE SLOW AND PRECISE.

FLIGHT OPERATIONS IN THIS AREA ARE CHARACTERIZED BY LARGE POWER CHANGES AT THE DECK EDGE. THE PILOT SHOULD ENSURE THAT THERE IS SUFFICIENT POWER AVAILABLE FOR A NO WIND OGE HOVER IN THE EXISTING AMBIENT CONDITIONS PRIOR TO A TAKEOFF OR LANDING.

Figure 3-4. Wind Envelope (Sheet 4 of 4)

CAUTION

Moderate engine/rotor rpm droop and slight settling of the helicopter may be experienced immediately after liftoff while clearing the deck. Transient droop can be reduced by raising collective slowly and smoothly.

3. Helicopters taking off will avoid crossing the bow of the ship.

4. Rendezvous will be in accordance with Section III, Part IV.

RECOVERY PROCEDURES.

STANDARD SIGNALS. Any of the following standard signals may be given by flag hoist, blinker and/or radio:

1. SIGNAL DELTA. The flight leader will orbit his flight in the designated pattern.

2. SIGNAL CHARLIE. Commence landing.

DELTA PATTERN (HOLDING PATTERN). The Delta pattern for helicopters is as designated in the NWP 42 series or by the individual ship. More than one Delta pattern may be designated. This pattern may be assigned to any helicopter or flights of helicopters during launch or recovery operations. When helicopters are orbiting in a Delta pattern, they will be prepared to break on order from Primary Flight Control to join the Charlie pattern.

LANDING PATTERN ENTRY/BREAKUP PROCEDURES. Unless cleared by PRI-FLY or direct entry, helicopters shall approach the ship on a heading that will parallel the ship's base recovery course close aboard the starboard side. The flight leader starts his upward turn 400 yards ahead of the bow at 300 feet altitude. Each succeeding helicopter breaks to maintain a minimum but safe interval.

CHARLIE PATTERN. This pattern is a race track landing pattern oriented on the port side of the ship and extending upwind a sufficient distance to allow a normal landing interval between helicopters. A designated altitude of 300 feet and 80 KIAS are maintained until starting the approach to landing. On the downwind leg during daylight operations, airspeed is reduced to arrive at the 180-degree position at 70 KIAS, 300 feet of altitude and about 400 yards abeam of the carrier. During night operations, the 180-degree position is 70 KIAS, 300 feet of altitude and about 600 yards abeam of the ship. Depending on the relative wind, the turn into the final approach is normally started at a position even with the bow or just ahead of the intended landing spot.

FINAL LANDING PROCEDURES. The approach turn from the 180 degree position is begun at 70 KIAS, adjusting speed as necessary to maintain a rate of closure commensurate with the relative speed of the ship. The final approach should be relatively flat to eliminate the necessity for exaggerated power changes or excessive flares near the deck. Final movement of the helicopter onto the deck position is normally accomplished by forward and starboard movement of the helicopter at air-taxi speed from the deck edge about 8 to 10 feet above the deck. The pilot is advised by signals from the LSE. Tiedowns shall be attached prior to shutdown. Rotor RPM shall not be decreased or engines shut down until signalled by the LSE.

NOTE

A wave-off or hold signal from the LSE is mandatory.

STARBOARD APPROACH. The starboard approach may be authorized to facilitate ordnance evolutions (including approaches with hung ordnance) aboard LPH and LHA class ships. When directed by PRI-FLY, enter the normal downwind at 80 knots, 300 feet altitude and approximately 500 yards abeam the ship. Continue downwind to a 180 degree position past the ship's stern turning to parallel the base recovery course about 50 yards on the starboard side. Reduce altitude and airspeed as necessary to permit a flat slide across the deck edge in a controlled air taxi. During the final portion of the approach, slide on an approximately 45 degree angle to the intended landing spot. The aircraft should be landed on the spot parallel to the ship's centerline.

NOTE

On starboard approaches with unsafe guns, hung or unexpended ordnance, the final slide should be on a 30 degree angle to the intended landing spot with about a 15 degree nose right skid. The aircraft should be landed on the spot pointing to the ship's 1 o'clock position.

EMERGENCY PROCEDURES. Any helicopter experiencing trouble in flight will immediately notify the flight leader by radio or by visual signals as the situation dictates.

If the nature of the emergency warrants an immediate return to the ship, a radio call will be made to enable the ship to prepare for landing. In any case, the following information will be transmitted to the ship:

1. Side number of the helicopter.
2. Position.
3. Difficulty.
4. Intentions.

If the helicopter having the emergency does not have a radio contact with the parent carrier, all possible information is relayed visually to the wingman who makes the necessary radio transmission. If communications are lost, the helicopter signal to indicate an emergency is as follows: Turn NAVIGATION LTS to FLASH and landing light to ON during the approach to the carrier.

AIR CAPABLE SHIP OPERATIONS.

Air capable ships include all ships other than aviation ships (CVs) and amphibious aviation ships (LPHs/LHAs), for example, LPD, LSD, LCC, LKA, DD, CG, etc. Basic shipboard procedures used on LPH and LHA class ships normally apply to operating on air capable ships as set forth in NWP 42. Pilots should be aware that except for LPDs, air capable ships have no air department and will have little experience operating with Marine helicopters. LPDs have two landing spots and all other air capable ships with a landing capability have one. Specific ship helicopter capabilities including obstruction and specific restriction are included in "Air Capable Ship's Helicopter Facility Resume" (NAEC-ENG-7576).

Launch Procedures.

The LSE will signal for launch to either port or starboard depending on obstructions and relative wind (usually with 30 degrees of the ship's heading). Following the LSEs signal to lift, the pilot will lift into an 8 to 10-foot hover and depart the ship using one of the following methods:

1. Slide perpendicular to the ship's centerline over the deck edge to a minimum of one rotor diameter from the ship; then transition to a normal climb into the wind.
2. When wind conditions are favorable and there are no obstructions to flight; transition from a hover, parallel the extended lineup line, and climb straight away from the ship (approximately 45 degrees from the ship's heading).

NOTE

Special care must be exercised to remain clear of crane and deck edge obstructions.

Recovery Procedures.

Helicopters will be recovered individually from the designated delta pattern. Landing patterns are normally flown at 300 feet and 80 knots. The final approach should be relatively flat to avoid flares in the immediate vicinity of the ship. Normal recovery procedures are as follows:

1. Obtain landing clearance and wind condition from the ship.
2. At the abeam position, commence a normal approach. Fly the approach down the approach line to arrive just short of the deck edge about 10 feet above flight deck level with a gradual transition to an air taxi condition; continue over the deck edge over the approach/lineup line; land with the skids in the center of the circle and the axis of the aircraft over the lineup line. Touchdown will be smooth.

NOTE

Due to the potential turbulence caused by the ship's superstructure and/or flight deck edge, and slow airspeed while crossing over the deck edge, gross weights should be limited to HOGE.

Stabilized Glide Slope Indicator (SGSI).

SGSIs are designed for use on air capable ships to provide a visual assist to helicopter approaches, including operations at night and during conditions of reduced visibility. These units are being installed on some surface ships.

NOTE

SGSI pilot procedures are different from those used with the standard Marine glide angle indicator light (GAIL), therefore reference must be made to NWP 42 for proper SGSI procedures.

	AH-1 LIGHTS	
Condition	Ship Red Deck Lighting	Ship White Deck Lighting
Ready for external power	As required	As required
Ready to start engines	Nav lights FLASH DIM	Nav lights FLASH DIM
Ready for takeoff	Nav lights STEADY DIM	Nav lights STEADY BRT Anticollision light ON
After takeoff	Nav lights STEADY BRT Anticollision light ON	Nav lights STEADY BRT Anticollision light ON
Established downwind prior to 180° position	Nav lights STEADY DIM Anticollision light OFF	Nav lights STEADY DIM Anticollision light OFF
After final landing or holding on flight deck	Nav lights STEADY DIM Anticollision light OFF	Anticollision light OFF

Figure 3-5. Lighting Procedures NTSA 80

NIGHT OPERATIONS.

Preflight Procedures.

The pilot's red-lensed flashlight will be used in making the external inspections. In addition to the normal cockpit inspections, ensure that all light switches are positioned properly. Lighting at night becomes a critical area, and the general rule of not showing white lights on the flight deck should be rigidly observed.

Helicopter Lighting.

NEW The helicopter lighting procedures (figure 3-5) shall be used for all night shipboard operations.

Taxi and Operations.

The first rule the pilot should remember concerning night shipboard operations is that the tempo of operations, both in volume and speed is considerably reduced from day operations. Slow and careful handling of helicopters by both helicopter directors and pilots is mandatory. When a pilot has doubts about an LSE's signal, he should hold his position and request confirmation from PRI-FLY. NEW

Postflight Procedures.

Postflight procedures and the postflight inspection are performed in the same manner with the same caution concerning night visibility as is required for preflight operations.

DEBRIEFING.

When based aboard ship, debriefing can be equally as beneficial as that required when based ashore. For detailed debriefing, refer to this section. Debrief those portions applicable to the flight.

PART 4 — SPECIAL PROCEDURES

FULL AUTOROTATION LANDING.

A full autorotation landing is performed in the same manner as the practice autorotation with power recovery with the exception that the throttles remain in the engine idle detent when the flare is commenced. At about 10 to 12 feet of actual altitude, smoothly raise the collective pitch control to slow the rate of descent, apply sufficient forward cyclic control to level the helicopter, and maintain heading with directional control pedals. Do not land in a skid. At about 2 feet altitude increase the rate of collective pitch control movement so as to effect a gentle touchdown. When the helicopter is on the ground, stop collective pitch control movement and allow the helicopter to slide to a gradual stop, maintaining heading. The touchdown will be made in a near level attitude, to prevent adverse pitching of the helicopter.

CAUTION

Zero airspeed autorotative landings should be avoided except in actual emergencies when the available landing surface is unsuitable for a sliding landing.

FORMATION AND TACTICS.

Introduction.

It is essential that the basic fundamentals of formation flying be practiced in preparation for combat readiness. The procedures and positions contained herein are intended to provide a foundation for formation flying which will meet most mission requirements, both combat and non-combat.

The signal for a change in a formation may be accomplished by the use of the radio on a squadron common frequency or appropriate hand signals as contained in NWP 50-2.

In any case, no changes in the formation will take place until all aircraft in the formation understand and acknowledge the signal.

Formations.

ELEMENTS OF A FORMATION.

The number of aircraft required to accomplish a mission varies. A section will consist of two aircraft, and a division will consist of three or four aircraft (two sections). Two or more divisions constitute a flight. The disposition of members within a formation is at the discretion of the leader.

BASIC FORMATIONS.

The two basic types of formations are parade and tactical. Parade is used primarily when there is a

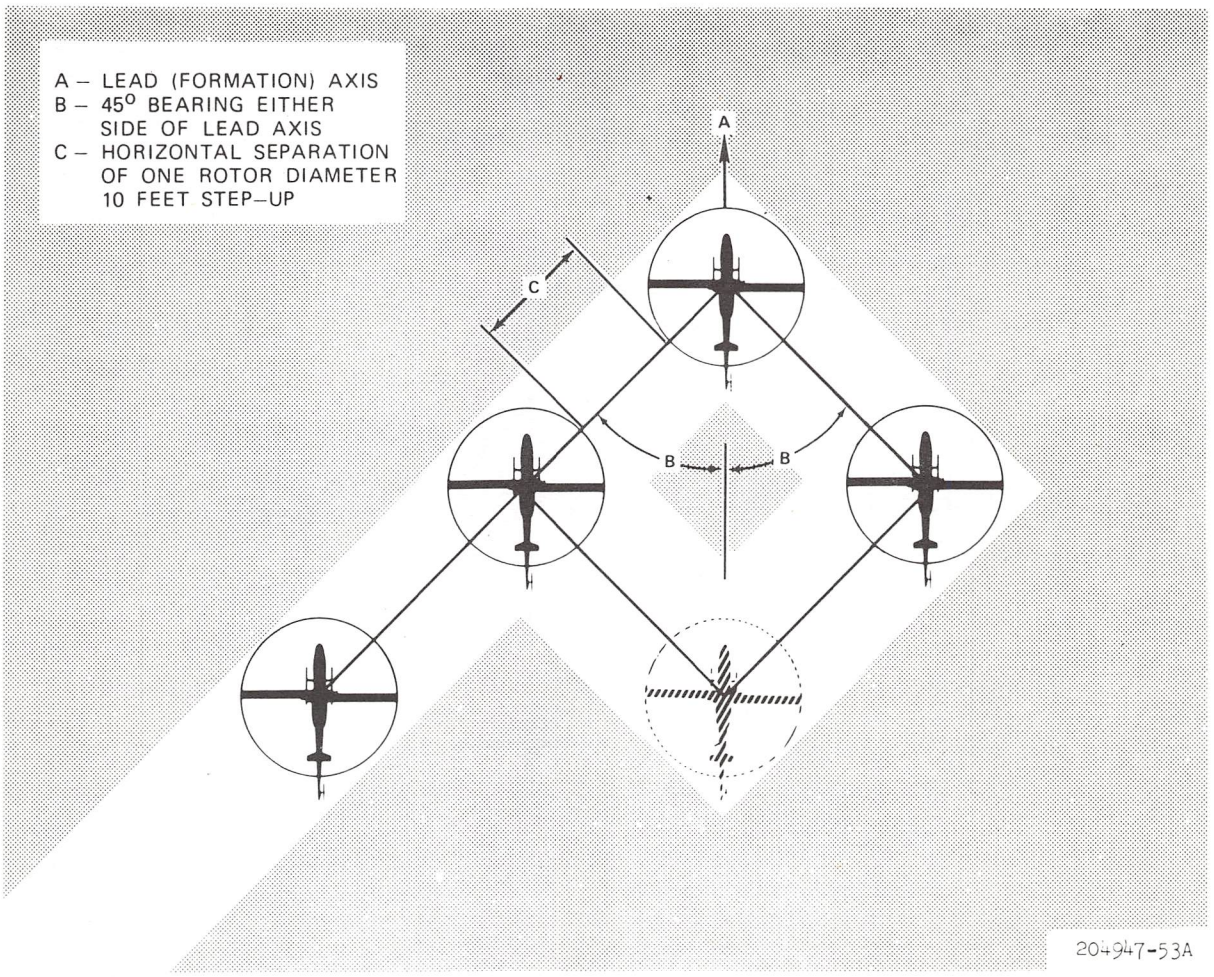


Figure 3-6. Fingertip Parade

requirement of aircraft to fly a fixed bearing position in close proximity to each other and maximum maneuverability is not essential. It is most frequently employed during arrival at or departure from ships or airfields, or during flight demonstrations. Power is varied to maintain position. Maneuverability is a prime consideration for formations engaged in combat tactics. The leader must be able to use his formation as an integral unit and still be free to turn, climb, and dive the formation with few restrictions. The tactical formations outlined herein afford this flexibility. Radius of turn is varied rather than power to maintain position.

Parade Formations.

TYPES.

The four basic types of parade formations are: echelon, fingertip (figure 3-6), diamond (figure 3-7), and column.

POSITIONS.

The parade position for echelon, fingertip and diamond is on a 45 degree bearing either side of lead axis with 10 feet of step-up, and one rotor diameter diagonal clearance. This position provides adequate longitudinal and lateral clearance between aircraft. In fingertip and diamond, the section leader will fly the same position on the leader as the number two man. The column position is on a 0 degree bearing with 10 feet of step-up and two (2) rotor diameters longitudinal clearance.

PARADE TURNS.

ECHELON AND FINGERTIP. Wingmen will rotate about the leader's longitudinal axis during a turn into them, and on their own longitudinal axis on turns away from them.

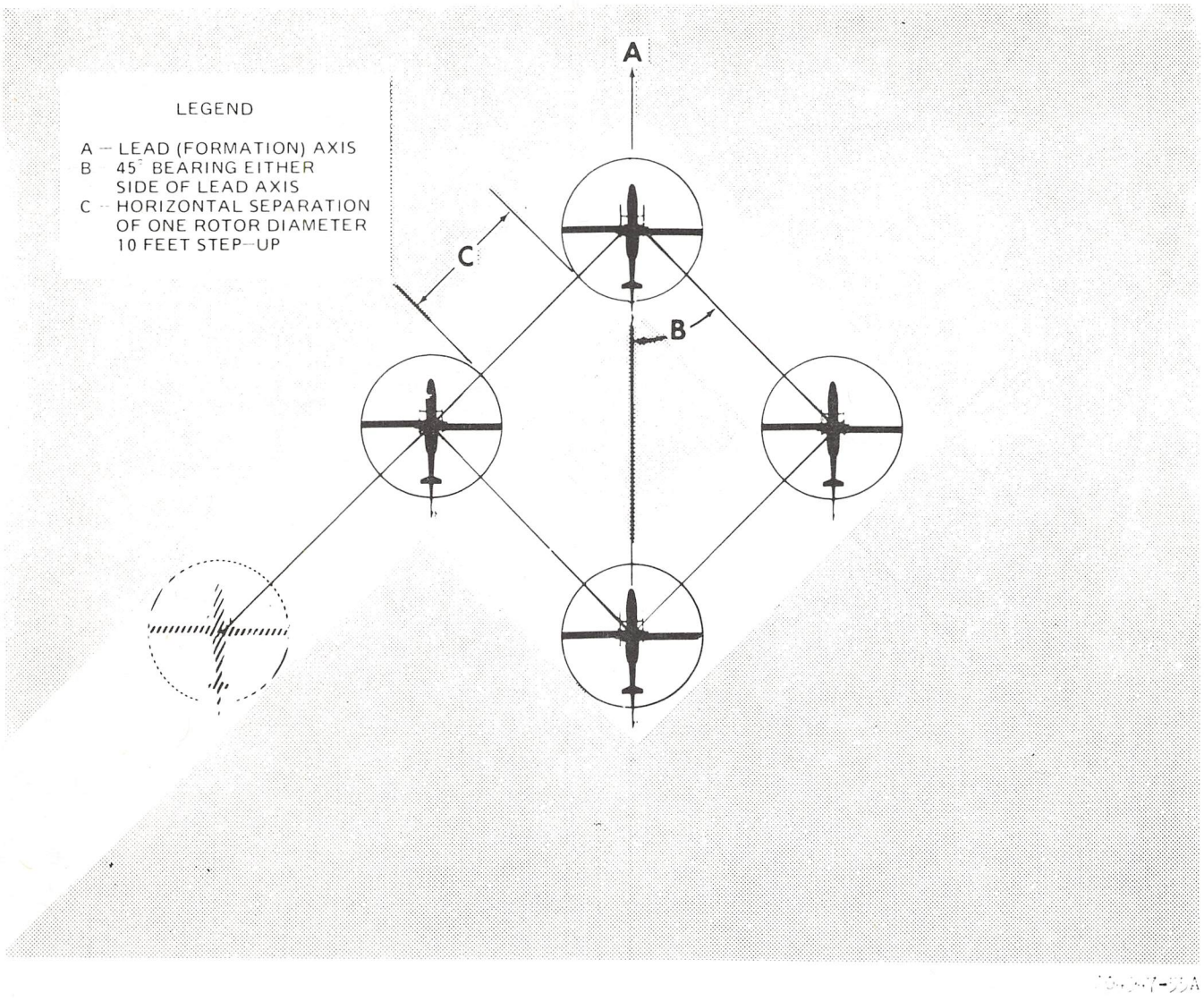


Figure 3-7. Diamond Parade

DIAMOND AND COLUMN. Wingmen will maintain a fixed position and roll about the leader's longitudinal axis on all turns.

CROSSOVERS.

Crossovers shall be accomplished by individual wingmen, or sections when directed by the leader. The leader shall ensure that all helicopters in his formation are aware of the change in formation. The following procedures will be followed:

1. When a wingman is required to crossover, he will move to the corresponding position on the opposite side maintaining longitudinal blade tip clearance constant. The section leader will slide out on bearing allowing room for the number two aircraft when applicable.

2. When the section is required to crossover, it shall be accomplished by the section moving across to the appropriate position on the opposite side. The section leader's wingman will not affect his crossover on the section leader until the section leader is in his new position.

LEAD CHANGES.

All changes of the lead position in a formation shall be acknowledged by the recipient in such a manner as to preclude the possibility of misunderstanding by any member of the formation. Preferably, a lead change will be executed from level flight and in such a manner as to allow the old leader time to assume his new position before maneuvering flight is commenced. The old leader shall maneuver to establish step up and maintain one rotor diameter separation while he moves back to his new position.

Tactical Formations.

TYPES.

The three basic types of tactical formations are: cruise (figure 3-8), tail chase, and combat spread.

CRUISE.

The cruise position is on a 30 degree bearing off the tail with 10 feet of stepup, and two (2) rotor diameters diagonal clearance. This position will provide adequate longitudinal and lateral clearance between aircraft for maximum maneuverability. Number three will fly a position to allow room for number two between himself and the leader. When the leader initiates a turn, aircraft will maintain longitudinal clearance on the aircraft directly ahead by sliding and utilizing the radius of turn created by the leader. To decrease distance, increase bank; to increase distance, decrease bank. As soon as the leader rolls level the normal cruise position will be resumed with the No. 2 aircraft balancing the formation.

TAIL CHASE.

The tail chase formation is flown in a loose column and all wingmen will utilize basic cruise-turn principles to maintain longitudinal clearance between aircraft. The formation is most commonly used in conjunction with the basic cruise formation when the leader is required to maneuver extensively through climbs, dives, and turns for the purpose of defensive evasive maneuvering, approaches to confined lz's, etc. When the need for the tail chase ceases, the leader should return the formation to normal cruise formation.

COMBAT SPREAD.

Combat spread is the basic formation used by flights of armed helicopters in the conduct of their mission. Variations of combat spread are used as a basis for establishing escort formations. Maneuvering in combat spread is accomplished using the basic fluid four techniques (radius of turn and altitude advantage are used to maintain/regain position in the flight). Exceptions to the use of fluid four are necessary when a flight is required to execute a break. Refer to NWP 55-3-AH-1, Vol. I.

RENDEZVOUS.

The two types of basic rendezvous are the running rendezvous and the carrier type rendezvous. A combination of the principles of these two is most commonly employed to join aircraft after takeoff.

Running Rendezvous.

The leader will depart maintaining a prebriefed airspeed and will allow wingmen to use an airspeed differential and/or radius of turn that will enable them to overtake the leader and join as briefed.

Carrier Type Rendezvous.

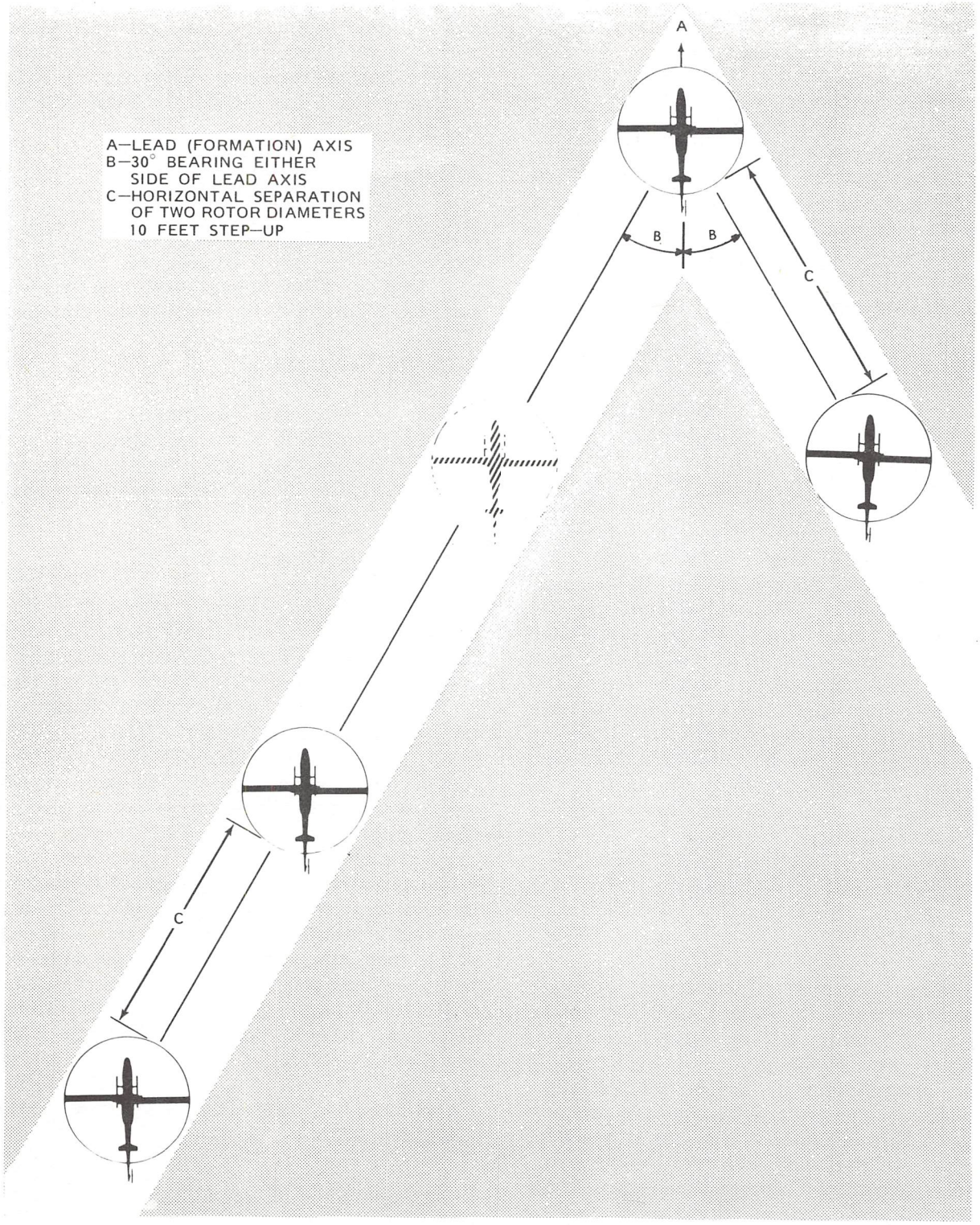
Basically this is a join-up executed while the division leader makes a 180 degree level turn, using a 10 degree to 15 degree angle of bank and 100 KIAS. Joining helicopters will assume a rendezvous bearing on the division leader using the cut-off vector to affect the join-up. The final phase of the rendezvous will be on a 45 degree rendezvous bearing. Join-ups will be made to the inside of the turn. After relative motion is stopped, affect a crossover.

When practicing carrier type rendezvous, break-ups will be executed from an echelon. The leader will break maintaining altitude and a 30 degree bank throughout his turn. Each succeeding wingman breaks at a prebriefed interval with 30 degree of bank, adjusting his bank to be in an extended column position when the leader completes his turn.

FORMATION TAKEOFFS AND LANDINGS.

Formation takeoffs and landings are frequently used during normal missions and should be practiced.

Power available, size of zone, obstacles to flight, wind direction and velocity, enemy fire, terrain features, rotor turbulence, and other considerations will determine the positions to be assumed by members of a formation.



204947-54B

Figure 3-8. Four Plane Division Tactical Cruise

Responsibilities.
Section and division leaders must endeaver to fly as smoothly and as steadily as possible, maintaining constant altitudes, headings and power settings. Section and division leaders are responsible for maintaining positions within the formation as instructed. The leader is responsible for briefing, conduct, and discipline of the flight. He normally handles radio transmission for the flight, including takeoff and landing clearance. All section leaders must be prepared to assume lead of the division.

PART 5 — FUNCTIONAL CHECKFLIGHT PROCEDURES

INTRODUCTION.

Check Pilots.

Commanding officers will designate, in writing, those pilots within their command who are currently eligible to perform this duty.

Checkflights and Forms.

Checkflights will be performed when directed by, and in accordance with, OPNAVINST 4790.2 series and the directions of NAVAIRSYSCOM type commanders, or other appropriate authority. Functional checkflight requirements and applicable minimums are described below. Functional checkflight checklists are promulgated separately.

REQUIREMENTS.

Conditions Requiring Functional Checkflights.

Checkflights are required under the following conditions (after the necessary ground check and prior to the release of the helicopter for operational use):

A. At the completion of helicopter rework and all phase D inspections (all checkflight items required are prefixed A).

B. After the installation of an engine or engine fuel control, or any components which cannot be checked in ground operations (minimum required are prefixed B).

C. When fixed or movable flights surfaces or flight control system components have been installed or reinstalled, adjusted, or rerigged and improper adjustment or replacement of such components could cause an unsafe operating condition (minimum required are prefixed C).

PROCEDURES.

Functional Checkflight.

The following items provide a detailed description of the functional checks sequenced in the order in which they should be performed. In order to complete the required checks in the most efficient and logical order, a flight profile has been established for each checkflight condition and identified by the letter corresponding to the purpose for which the checkflight is being flown; i.e., A through C above. The applicable letter identifying the profile prefixes each check both in the following text and in the functional checkflight checklist.

FUNCTIONAL CHECKFLIGHT CHECKLIST.

Checkflight personnel shall familiarize themselves with these requirements prior to the flight. NATOPS procedures shall apply during the entire checkflight unless specific deviation is required by the functional check to record data or ensure proper operation within the approved aircraft envelope. A daily inspection is required prior to the checkflight. Checkflight pilots shall be briefed by Maintenance Control or Quality Assurance personnel prior to flight.

Before Preflight.

The check pilot shall ensure the following have been accomplished:

1. All discrepancies have been signed off by the inspector; a qualified plane captain has signed off the preflight and a responsible authority has signed the helicopter off as safe for flight.

2. The purpose of the flight portion of the check card has been properly filled out.

3. There is no doubt what is required for a complete and accurate check.

4. The plane captain has unbuttoned each portion of the helicopter that is accessible to preflight. Keep in mind the most important aspect of a checkflight is the PREFLIGHT and POSTFLIGHT.

WARNING

Do not begin maintenance flight readiness inspection until armament systems are determined to be safe.

PROFILE.

ABC

Exterior Check.

1. Main rotor blades — Visually check condition and cleanliness.
2. TSU — Security, cleanliness.
3. Emergency canopy jettison — Secure, unobstructed.
4. Cover — Condition, all screws installed.
5. Stress panels — Secure, all screws installed.
6. Gun turret — Dzus fasteners secured, skin damage, gun locked in stow position, no excessive play in barrel.
7. Copilot/gunner windshield and window — Check for heat damage, scratches, evidence of leakage.
8. Rain removal — Unobstructed.
9. Static ports — Check for damage, obstruction (i.e., painted over).
10. Stress panels — Right side secure, all screws installed.
11. Ammunition bay — Trays installed properly with security pins in place. White teflon slides and door cables for damage. Condition, operation, and proper latching of bay door.
12. Pilot canopy door — Check for excessive scratches, damage or discoloration, proper fit, handles for damage, hinges and screws secured.
13. ADF and FM — Sensing and homing antenna for damage and proper installation.

14. Hydraulic compartment — Lines and fittings for security and leakage, all bypass button indicators in, reservoirs full, ECU duct for condition, and door latches for condition and operation. Gravity refueling cap — Secure.

NEW

15. Right wing — Surface condition, navigation and formation light for cracked glass and security. Ensure safety levers are locked and safety pins in. Check slip marks on 4 mounting bolts. Check tiedown ring is secure.

16. Compartment under wing — Check lines for leakage, looseness, cleanliness, chaffing; fore/aft servo and synchronized elevator control rods for security and leakage.

17. Landing gear — Check fairing for damage; fuselage for wrinkles (evidence of hard landing); cross tubes for bends; skid shoes for proper installation, damage and security; weather stripping for installation and security.

18. Transmission area — No foreign material, check oil leakage, check mounts for lockwire, wear or damage, ensure control tubes are not rubbing lines or airframe, dampeners, and lines for fraying.

19. Rotor brake disc — Condition, security.

20. Transmission oil jets — Installed, safetied.

21. Power cylinder mounts, hydraulic pumps, and tachometer generator — Secure.

22. Lift link — Check for cracks, bends, security of attaching points.

23. Tail rotor driveshaft — No grease leakage or scratches.

24. Main driveshaft — Proper alignment, not throwing grease, check drain line from input quill. Check proper operation of free wheeling unit (rotate to port side).

NEW

25. Transmission oil filler cap and sight gage — Security of cap and proper oil level.

26. Transmission chip detector plug and drain — Securty, leakage, and lockwire.

27. Accessory gearbox area — Check throttle linkage and all accessories for condition. Check for fuel and oil leakage.

28. Engine intake area — Check for cleanliness, security, damage, and foreign matter.

29. Engine oil tank — Proper oil level, leakage, filler cap security, and chip detector lockwired.

30. Transmission cowling — Check fasteners, hinges for cracks and proper fastening. Check number 1 hydraulic filter buttons.

31. Engine compartment — Check for fuel and oil leakage; all lines and wiring for tightness, chafing, leakage, and security. Check Nf governor linkage for security. Check oil cooler blowers for security and foreign matter. Check engine mount. Check hanger bearings.

32. Transmission oil filters — Bypass indicator in.

33. Combining gearbox — Check for oil level, leakage, and security of chip plug.

34. Exhaust pipe — Note any evidence of oil and check for cracks. Check for security of thermal cover.

35. Combustion chamber area — Check for fuel leakage; condition of fire detector; no obstruction to fire extinguisher.

36. Exhaust extension — Check for cracks, chafing, or looseness.

37. Engine cowling — Check fasteners and hinges for cracks and proper fastening.

37a. Pressure refueling receiver cap — Secure. NEW

38. Electrical compartment — Battery for security, cleanliness, evidence of corrosion, leakage, vent lines clear, and lockwired. Tail rotor servo for leakage, all lines and wires for tightness, tailboom mounting bolts for looseness (slip marks), all circuit breakers in, and inverters for proper installation.

39. Tailboom (right side) — Skid condition, popped rivets, structural damage, all access panel fasteners installed.

40. Driveshaft cover (right side) — Condition and security of skin and hinge.

41. Synchronized elevator (right side) — Skin condition and excessive play in spar. Check trailing edge for separation.

42. 42 degree gearbox — Security, grease and oil leakage; filler cap and cover secure. No dzus fasteners absent or cracks in cover. Check oil level.

43. Tail skid — No excessive play.

44. Aft navigation lights — Check for loose rivets, cracked glass, and condition.

45. Vertical fin (right side) — Skin condition, loose or popped rivets.

46. Tail rotor blades — Check for damage, freedom, free to flap, and tiedown removed.

47. Tail rotor hub and components — Check for excessive looseness of the yoke and crosshead bearings, counterweights for correct positioning, pitch change links for correct installation and wear, check appropriate components are lockwired.

48. 90 degree gearbox — Oil level, leakage, filler cap — secure.

49. Vertical fin (left side) — Skin condition, loose or popped rivets.

50. Vertical driveshaft cover — Hinges and fasteners for security.

51. 5th driveshaft — Scratches, dents, condition of 42 degree gearbox driveshaft fan.

52. 2nd, 3rd, and 4th driveshaft — Associated hanger bearings and clamps for grease, security, nicks, dents, scratches.

53. 42 degree gearbox — Check for oil leakage and level.

54. Driveshaft cover (left side) — Condition, cracks, dzus fasteners installed and secured.

55. Tailboom (left side) — Skin condition, popped rivets and structural damage, check underside for breather screens attached and screws in place.

56. Synchronized elevator (left side) — Skin condition and excessive play in spar. Check trailing edge for separation.

57. Electronic access panel — Check condition of doors and ensure electronic equipment is secure with wires attached properly.

58. Exhaust pipe — Note any evidence of oil and check for cracks.

59. Exhaust extension — Check for cracks, chafing, and looseness.

60. External power receptacle — Security of unit, prongs, and door secured.

61. Fire extinguisher and radio access panel — Check condition of door, pressure in fire bottles (550-700 lbs.), red indicators not discolored, check linkage and droop cam, wires for security.

62. Engine compartment — Check for fuel and oil leakage, all lines and wiring for tightness, chafing, and security, check engine mounts for axial play and cracks. Check combining gearbox oil filter bypass indicator.

63. Engine cowling — Check fasteners and hinges for cracks and proper fastening.

64. Accessory gearbox — Check throttle linkage and all accessories for condition. Check for fuel and oil leakage.

65. Engine oil tank — Proper oil level, leakage, filler cap secure.

66. Transmission — Lift link, main driveshaft, mounts, lockwire, rotor brake, mount and bolts for cracks.

67. Transmission cowling — Check fasteners, hinges for cracks, proper fastening, and pitot tube.

68. Number 1 hydraulic gage — Check level.

69. Pylon access doors — Check hinges and operation. Check number 1 hydraulic reservoir and filter for leakage and condition.

70. Drive links — No excessive looseness.

71. Anti-drive link — No excessive looseness.

72. Mast boot — Check for security and damage.

73. Friction collet — In place, secure.

74. Segmented clamp — Secure.

75. Scissors assembly — No excessive looseness.

WARNING

Bolt attaching control tube to scissor assembly must be installed opposite to direction of rotation.

76. Lower bearing — Check for excessive looseness.

NOTE

Particularly check scissors area for wear.

77. Swashplate — No vertical looseness or visual wear. Rotating swashplate — Check for lockwire and condition.

78. Collective sleeve hub — Check for security and condition.

79. Static stops — Check for evidence of mast bumping and check attaching bolts for shear offset.

80. Mast — Check for scratches, nicks, dents.

81. Upper bearings — No excessive looseness.

82. Pitch change rod and barrel — Scratches, dents, lockwire, jamnuts secure.

83. Main rotor hub — Check for damage and corrosion.

84. Grips — Check oil level and leakage.

85. Pitch horn — Check rod end attachment for looseness of bolts, nicks and scratches.

86. Drag brace — Check condition and locknuts secure.

87. Trunnion and bearing — Check for looseness of bolts.

88. Blade attachment bolts — Condition, locks installed.

89. Mast nut — Secure with lock in place.

90. Main rotor blades — Check for bonding separation, cracks, cleanliness.

91. Upper cowling and anti-collision light — Check for damage, security, and operation.

92. Left wing — Surface condition, position and formation light for cracked glass and security. Ensure safety lever is locked and safety pin is in. Check slip marks on 4 mounting bolts. Check that tiedown ring is secure.

93. Compartment under wing — Check leakage, lateral servo, collective servo, lines for chafing.

94. Landing gear — Check fairing for damage, fuselage for wrinkles (evidence of hard landing), crosstubes for bends, skid shoes for proper installation, damage, and security, weather stripping for installation and security.

95. Hydraulic compartment — Check ECU, access door and latches, rotor brake cylinder for security. Check transmission chip detector lights.

96. Stress panels — Condition.

97. Ammunition bay — Trays installed properly with security pins in place. White teflon slides and door cables for damage. Condition, operation, and proper latching of bay door.

98. Pilot window — Check for scratches, discoloration.

99. Copilot/gunner canopy door — Check for scratches, discoloration, proper fit, handle and hinges for damage.

100. Static ports — Check for damage or obstruction.

Pre-Entry Inspection.

As stated in NATOPS normal procedues; Section III, Part 2.

ABC **Interior Inspection (pilot station).**

1. First aid kit installed, unopened.

2. Condition of det cord.

3. Check all gages for limit marks and proper installation.

4. Proceed with interior inspection as stated in NATOPS normal procedures, Section III, Part 2.

Start.

ABC

1. After electrical power has been applied to helicopter, the following lights should be illuminated on the master caution panel:

NEW

ENG 1 OIL PRESS, ENG 2 OIL PRESS

90° TEMP/PRESS, 42° TEMP/PRESS

ENG 1 PART SEP OFF, ENG 2 PART SEP OFF

NO. 1 DC GEN, NO. 2 DC GEN

XMSN OIL PRESS

C BOX OIL PRESS

NO. 1 HYD PRESS, NO. 2 HYD PRESS

AC MAIN

XMSN OIL BYP

FWD FUEL BOOST, AFT FUEL BOOST

EXT PWR DOOR OPEN (only if external power door is open)

ALT ENCODER (light disabled if AAU/32 is installed)

ABC 2. Engine 1 — Check engine idle (62 ± 2% Ng). NEW

ABC 3. Engine 2 — Check engine idle (62 ± 2% Ng). NEW

4. Flight controls — Refer to page 3-10

5. Force trim — Refer to page 3-10

ABC 6. Hydraulic check — Refer to page 3-10

AB 7. Acceleration check — Throttle both engines to engine idle and check RPM switch full decrease (engine idle 61 +1% GAS PROD (Ng)). Rapidly open No. 1 engine throttle monitoring INLET TEMP and GAS PROD (Ng) speed. When GAS PROD (Ng) passes 90%, rapidly close throttle to engine idle. Time for acceleration from engine idle to 90% GAS PROD (Ng) should be 5 seconds maximum. NEW

AB 8. ENG RPM (Nf) Governor — Differential trim check — With throttles full open, actuate ENG TRIM switch to full minus and note engines torque spread (#2 torque lower than #1). Then actuate ENG TRIM switch to full plus and note engines torque spread (#2 higher than #1); the torque differential should be approximately equal from full minus to full plus. Dual beep check — With throttles full open, actuate ENG TRIM switch to match engine torques; then with RPM switch, check dual governor range at 97% RPM (Nf) full decrease to 101.5 ±0.5% ENG RPM (Nf) full increase. Running the governor through full range should take 5-10 seconds. Engine trim — With throttles full open and ENG RPM (Nf) set at 100%, pull in sufficient collective to obtain a light on the skids condition. Check that the torque of the engines are within 3% of each other. Check TRIM switch for a minimum of ± 3%. NEW NEW

a. No. 1 engine idle and No. 2 engine full throttle.

b. Record maximum RPM for No. 2 engine.

c. Repeat above for No. 1 engine.

NEW

d. Single engine maximum rpm should be between 98-100% ENG RPM (Nf).

AB

9. T5 BIAS — With one engine 700°C or above INLET TEMP, activate BIAS TEST switch to selected engine and record the change in INLET TEMP. It should be the data plate bias ± 5°C. If not, adjust accordingly. Repeat process for the other engine.

CAUTION

A bias greater than that data plate bias could result in an inadvertent overtemp.

AB

10. Ground power assurance check — (on deck) Perform the ground power assurance check with the helicopter headed within 5 degrees of the prevailing wind.

a. Set 29.92 in altimeter and record altitude.

b. Determine and record torque required.

c. Check tower for current OAT in degrees C and winds. Check helicopter FAT gage. Record both temperatures. Use the lower temperature or indicate temperature used.

d. Determine and record max allowable INLET TEMP and GAS PROD (Ng).

e. Roll No. 1 throttle full open. Pull in torque determined in b above. Maintain 97% ENG RPM (Nf).

f. Allow 5 minutes stabilization time and record:

(1) GAS PRGD (Ng) to nearest tenth.

(2) INLET TEMP to nearest 5 degrees.

(3) ENG TORQUE.

NEW NEW NEW NEW NEW

AB

11. Particle separator, (Engine RPM) warning — With engines above engine idle move PART SEP switch of No. 1 engine to the OFF position and check MASTER CAUTION light illuminates (PART SEP OFF). Move switch to the ON position and check light is out (there will be a slight delay before light goes out). Move switch to AUTO position and check that light does not illuminate. When the TRIP TACH or RPM WRN circuit breakers are out, the particle separator is inoperative in the automatic mode. Repeat above for No. 2 engine. Reduce throttle below engine idle, record GAS PROD (Ng) when respective PART SEP OFF and MASTER CAUTION and RPM lights illuminate.

NOTE

Nr must be above 92% for RPM warning light to be extinguished.

ABC

12. RPM caution system — Check that the RPM caution light will illuminate when: GAS PROD (Ng) of either engine decreases to 52.5 ±2% or ROTOR RPM decreases to 92 ±2% Nr. The RPM caution audio signal comes on when rotor rpm decreases to 92 ± 2%.

AB

13. Boost pump check — Pull FUEL FWD BOOST pump circuit breaker. Check FWD FUEL BOOST and MASTER CAUTION lights illuminate. Record aft boost pump pressure (5-25 psi). Pull FUEL AFT BOOST pump circuit breaker. Check FUEL AFT BOOST and MASTER CAUTION light illuminates and ensure that FUEL PRESS goes to zero. Let the engines run for one minute to ensure that both engine fuel pumps can draw fuel from the fuel cells. Reset FUEL FWD BOOST pump circuit breaker and record forward boost pump pressure. Position the CROSS FEED switch to CLOSED position. Check that the pressure goes to zero. Let the engines run for 1 minute and reset FUEL AFT BOOST circuit breaker in. Turn CROSS FEED ON. Check fuel pressure. NEW

AB

14. Generators:

Condition 1.

NON-ESS BUS — NORMAL

GEN 1 — ON

GEN 2 — OFF

Check No. 2 DC GEN caution light and MASTER CAUTION light illuminated; AMPS 2 load zero. Non-Ess Bus electrical equipment operative. Record No. 1 DC GEN volts and amps. Repeat for No. 2 DC GEN. NEW

Condition 2.

NON-ESS BUS — NORMAL

GEN 1 — OFF

GEN 2 — OFF

Check NO. 1 DC GEN and NO. 2 DC GEN caution lights and MASTER CAUTION light illuminated; generator loads zero; all Non-Essential Bus electrical equipment inoperative with AC MAIN and ALT ENCODER caution lights illuminated. ALT ENCODER light will not function if AAU-32/A altimeter is installed. NEW

NON-ESS BUS switch — MANUAL. Ensure that Non-Essential electrical equipment operative with battery power only.

Condition 3.

NON-ESS BUS — NORMAL

GEN 1 — ON

GEN 2 — ON

WEAPON CONT cb — OUTBOARD

MASTER ARM — STBY

Check NO. 1 DC GEN has assumed helicopter's normal electrical load and NO. 2 DC GEN has assumed the armament system electrical load.

Condition 4.

NON-ESS BUS — NORMAL

GEN 1 — ON

GEN 2 — OFF

WEAPON CONT cb — OUTBOARD

MASTER ARM — STBY

Check NO. 1 DC GEN has assumed the armament system electrical load. Helicopter normal electrical load is on battery power with the Non-Essential electrical equipment inoperative. The MASTER CAUTION light, NO. 2 DC GEN caution light AC MAIN caution light, and ALT ENCODER caution lights on.

ABC 15. Inverters:

a. Main inverter — all electrical equipment on, 113.5 ± 5 volts.

b. Standby inverter — all electrical equipment on, 113.5 ± 5 volts.

ABC 16. SCAS — Approximately 30 seconds after engaging SCAS POWER switch, the NO-GO lights should be out provided SCAS channels are disengaged and controls are stationary. Move cyclic forward slightly and note that NO-GO light illuminates. Hold all controls stationary and note the PITCH light goes out within 30 seconds. Move cyclic back to center and note PITCH NO-GO light illuminates. When NO-GO light goes out, engage PITCH channel. Repeat above for ROLL and YAW using appropriate control movements. After all channels are engaged, check cyclic SCAS release button in both cockpits. Move tip path twelve inches in pitch and note SCAS corrects back; repeat for roll.

NOTE

Visually observe main rotor tip path plane for excessive fluctuation when ROLL and PITCH channels are engaged. Excessive fluctuation is cause to abort check.

17. Ecu, rain removal, and pitot heat check — Engergize ECU and check INLET TEMP rise on both engine INLET TEMP gages (possible 10-25 degrees). Turn ECU off. Energize RAIN RMV and note INLET TEMP rise and windshield. Energize PITOT HTR and observe ammeter.

ABC 18. Compare cockpit instruments/gage. Record gage readings and note any gage splits between cockpits in excess of:

a. 1% ROTOR RPM (Nr), ENG RPM (Nf) and GAS PROD (Ng).

b. 2% TORQUE

c. 10 degrees INLET TEMP.

ABC 19. UHF radio — Check for operation.

ABC

20. Radar altimeter AN/APN-171(v) — ON. Allow 3 minutes warm-up, indicator OFF flag disappear and altitude pointer indicates zero feet. Press, PUSH-TO-TEST, a reading of 100 plus or minus 15 feet will be indicated if the system is functioning properly.

Hover Checks.

ABC

1. Controls — Check helicopter performs correctly to control inputs by hovering forward, rearward, sideward and turning left and right 360 degrees.

2. Pylon rock — With SCAS on, move cyclic fore and aft rapidly once or twice and center cyclic. Induced oscillations should dampen out within 4-5 cycles. If oscillations do not dampen, turn PITCH and ROLL SCAS OFF and repeat procedure; if oscillations dampen normally after 4-5 cycles, the pitch SCAS may be defective. NEW

3. Manual fuel — Set helicopter on deck and retard both throttles to engine idle. Place ENGINE 1 GOV to MANUAL and cautiously roll No. 2 throttle full open. Roll No. 1 throttle on to join torque needles. Lift helicopter to a hover. Set helicopter back down and return GOV to AUTO with throttles at engine idle. Repeat procedure for No. 2 engine. Check ENG GOV MNL advisory lights illuminates. While GOV is in MANUAL mode, check that the high rotor RPM caution light comes on at 103% ±2% ENG RPM (Nf). NEW

ABC

4. SCAS yaw check—Once established in a stable hover, with the force trim ON, pull in a 10-15% above hover torque without directional control input. Note that the helicopter attempts to slow the yaw rate. NEW

Flight Checks.

ABC

1. Torque limitor/droop cam check — At flat pitch, set ENG RPM (Nf) at 100%. Smoothly execute a full power climb not to exceed limits: 100% XMSN TORQUE, 101.8% GAS POD (Ng), or 837 degrees INLET TEMP. Check that ENG RPM (Nf) does not vary by more than 4.5 — 5.5% momentarily then restabilizes to 100% ± 1% ENG RPM (Nf). If Nf droops before engine limits are attained, adjustments are necessary. NEW NEW

ABC

2. Power available:

   a. Altimeter set at 29.92.

   b. ECU and RAIN RMV OFF.

   c. Climb to selected altitude and stabilize for one minute.

   d. Reduce one throttle to engine idle. Increase test engine to full RPM increase without changing engine trim.

e. Without exceeding helicopter or engine limits, increase power on the test engine until ENG RPM (Nf) droops to 97% or until an INLET TEMP or GAS PROD (Ng) limit is reached. Allow inlet TEMP to stabilize for a minimum of 30 seconds up to a maximum of 3 minutes, stabilizing only long enough to satisfy requirements. If INLET TEMP indicates 837°C prior to obtaining the ENG RPM (Nf) droop, climb to a higher altitude and repeat the test. If droop does not occur at 101.8 ± .5% GAS PROD (Ng) engine adjustments are necessary. NEW

NOTE

At extremely low OAT, ENG RPM (Nf) droop may occur prior to reaching INLET TEMP or GAS PROD (Ng) limits. This is a result of the engine reaching a maximum fuel flow limit of 640-660 pph. In addition, certain engines will not reach 101.8% GAS PROD (Ng) regardless of altitude, without exceeding the maximum INLET TEMP limit due to their internal speed and temperature match. This does not prevent the engine from achieving required performance. In these cases, record normal topping parameters at 97% ENG RPM (Nf) (beep if necessary, but maintain an INLET TEMP of 837°C by changing collective position) and compare them to the AH-1T topping chart requirements to insure that proper engine power is available. In order to set Maximum GAS PROD (Ng) limit stop for an INLET TEMP limited engine, utilize the part power trim stop and set GAS PROD (Ng) to 98.3 to 98.8%.

f. Insure that ENG RPM (Nf) is stabilized at 97%, then record OAT, altitude, ENG RPM (Nf), GAS PROD (Ng), INLET TEMP, and TORQUE.

g. Verify that test torque equals or exceeds the requirements of the power available chart. If chart torque cannot be equalled, instrument calibration and/or engine maintenance is required.

NOTE

Chart torque values have been reduced to allow for the most probable low readings due to allowable instrumentation error.

ABC

3. Hydraulic boost checks — In stabilized level flight at 100 KIAS, turn off the No. 2 hydraulic system, being prepared to return to ON if control forces become excessive in any manner. Note the following:

a. NO. 2 HYD PRESS caution light ON

b. MASTER CAUTION light ON

c. HYD 2 PSI indication near zero

d. PITCH and ROLL SCAS switches drop to "OFF"

e. Loss of pitch and roll SCAS

Perform 30 degree angle of bank turns in both directions and moderate nose up and nose down maneuver.

f. The NO. 1 hydraulic system should provide normal boost-on control responses in all controls without feedback, rate limiting, or motoring.

HYD switch ON and note normal operation. Engage PITCH and ROLL SCAS. Turn off Hydraulic 1 system with same precaution as above. Note the following:

a. NO. 1 HYD PRESS caution light ON

b. MASTER CAUTION light ON

c. HYD 1 PSI indication near zero

d. YAW SCAS switch drops to OFF

e. Loss of yaw SCAS

f. The NO. 2 hydraulic system should provide normal boost-on control responses in the cyclic and collective controls without feedback, rate limiting, or motoring. The directional pedals will be non-boosted but should be manageable through all normal maneuvers including hover and landing.

HYD switch ON and note normal operation. Engage YAW SCAS.

ABC

4. Normal Maneuvers — At airspeeds above 60 knots, the right pedal should be slightly ahead of the left pedal. 30-degree angle of bank left turns, at 55 knots, should be possible at full power. 30-degree angle of bank right turns should be possible while autorotating at 100 knots. There should be no need for excessive lateral control as airspeed is increased. NEW NEW

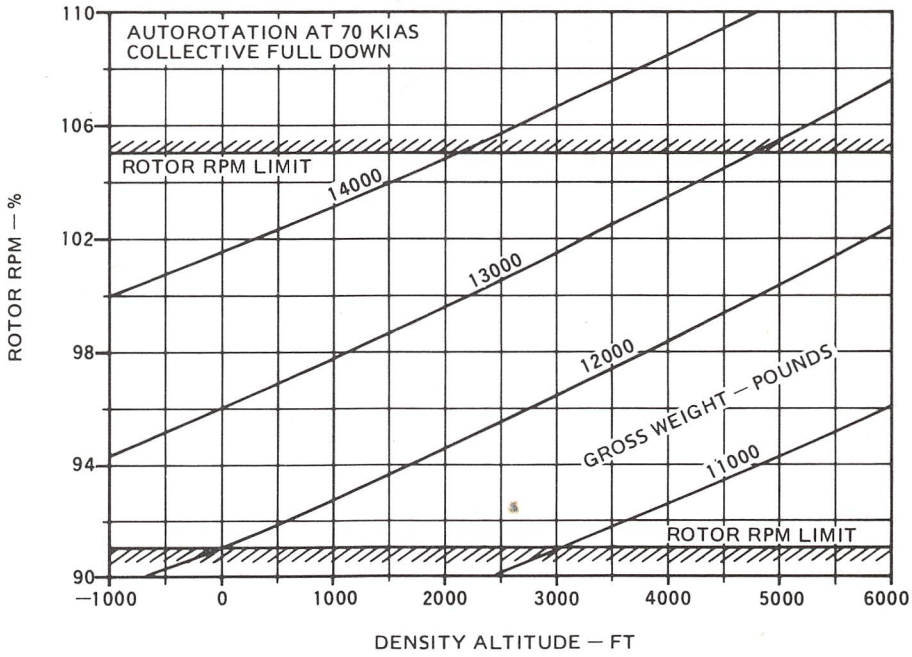
AB

5. Tracking and vibration — A vibration analyzer unit should be utilized to evaluate excessive helicopter vibrations. Refer to the appropriate maintenance manual for installation of unit, flight procedures, and data analysis.

AB

6. Autorotation rpm check — Autorotation to be conducted at 70 KIAS, balanced, unaccelerated, wings level flight, with collective full down. Record OAT, altitude, gross weight, and ROTOR RPM (Nr).

7. Avionics — Check operation of all equipment as stated in the appropriate technical manual.



AT HEAVY GROSS WEIGHT OR HIGH ALTITUDE, SLIGHTLY UP COLLECTIVE MUST BE USED TO PREVENT ROTOR OVERSPEED.

210900-73

Figure 3-9. Rotor Limit Chart

Shutdown.

ABC

1. Engine shutdown — In accordance with Checklist, Section III, Part 2.
2. Check PSI following caution lights illuminate out:

ENG	PSI
XMSN	PSI
C BOX	PSI

3. Rotor brake light.

NEW NEW NEW NEW

SECTION IV— FLIGHT CHARACTERISTICS

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INTRODUCTION.

The flight characteristics of this helicopter are similar to other single rotor helicopters. The basic flying qualities are enhanced by the Stability and Control Augmentation System (SCAS). This system provides good stability and control response throughout the operating flight envelope. The control system, with hydraulic servo assist, provides the pilot with a light force required for control movements; control feel is induced into the cyclic stick and tail rotor controls by means of a force trim system.

ROTOR BLADE STALL.

NOTE

Main rotor blade stall is not a problem in the AH-1T (TOW) helicopter when operated within the approved flight envelope. However, main rotor blade stall may occur at some combination of excessive airspeed and high "G" loading.

Blade stall occurs when the angle of attack of the retreating blade exceeds the specific stall angle for any blade segment. When the condition is attained, increased blade pitch (or collective) will not result in increased lift and may result in reduced lift. The threshold of stall is approached as gross weight, airspeed, altitude and "G" loading increase and rpm decreases. One of the more important features of the two-bladed, semi-rigid system is its warning to the pilot of impending blade stall. Prior to progressing fully into the stall region, the pilot will feel a marked increase in airframe vibration and, possibly, control feedback. Consequently, corrective action can be taken before stall becomes severe.

Blade Stall — Corrective Action.

The use of the following procedures is predicated on the helicopter's altitude above the terrain. Sufficient recovery altitude must be available for these to be effective. When blade stall is evident the condition may be eliminated by accomplishing one or a combination of the following corrective actions.

1. Reduce collective.
2. Reduce airspeed.
3. Decrease severity of maneuvers.
4. Increase operating rpm.
5. Descend to lower altitude, if appropriate.

CONTROL FEEDBACK.

Feedback in the cyclic stick or collective stick is caused by high loads in the control system. These loads are generated during severe maneuvers and can be of sufficient magnitude to overpower or feed through the main boost cylinders and into the cyclic and/or collective stick. The pilot will feel the feedback as an oscillatory "shaking" of the controls even though he may not be making control inputs after the maneuver is established. This type of feedback will normally vary with the severity of the maneuver. The pilot should regard it as a cue that high control system loads are occurring and should immediately reduce the severity of the maneuver.

WARNING

The copilot/gunner station side arm flight controls have a reduced mechanical advantage. Because of this reduced mechanical advantage of the copilot/gunner cyclic and collective controls, severe maneuvers should be avoided while flying from the gunner station. If the pilot-in-command elects to allow maneuvers to be flown from the copilot/gunner station, the rear seat pilot should monitor the flight controls and be capable of recovering to a safe attitude if required.

PITCH-CONE COUPLING.

Pitch-cone coupling is the tendency of the rotor blade to reduce pitch as thrust is increased or rotor RPM is reduced. With large amounts of pitch-cone coupling, the rotor may overspeed during pull-ups or flares unless the pilot adds collective pitch. The AH-1T (TOW) main rotor design minimizes pitch cone coupling.

MANEUVERING FLIGHT.

When performing maneuvers above 120 KIAS, it is necessary to devote more attention to flying and to planning manuevers due to the increased distance needed to perform pull outs and turns. The increased distance required for pull outs and turns is a direct result of the higher airspeed.

CAUTION

During left rolling maneuvers or high power dives, torque, Ng and ITT increases occur. Care shall be exercised to monitor instruments, especially the triple tachometer. This will enable the pilot to adjust power as required to prevent exceeding aircraft engine limitations and prevent a low rotor RPM condition. This can be accomplished by either lowering the collective, reducing the severity of the maneuver, or a combination of both.

Radius Of Turn.

At airspeeds above 130 KIAS the radius of turn and rate of closure increases rapidly due primarily to higher airspeeds. The turn radius is a function of the bank angle ("G" loading) and the square of the airspeed. For any given condition of altitude and weight, where the "G" capability is defined by rotor characteristics the turn radius can be markedly affected by airspeed. The effect of speed can be ascertained by an inspection of figure 4-1. From the examples A and B, it can be seen that for a bank angle of 30° (1.15 "G") the radius of turn is increased by a factor of four when the airspeed is increased from 80 KIAS to 160 KIAS. The same is also true in a dive recovery. Figure 4-2 provides a graphic chart of the turning radius in relationship to airspeed.

Low "G" Maneuvers.

AH-1T (TOW) helicopters have a tendency to roll to the right when forward cyclic is used to initiate a lower than one G maneuver in forward flight. The reason for this low G roll tendency is the thrust produced by the tail rotor. Because the tail rotor is above the helicopter's center of gravity, the tail rotor thrust produces a right roll tendency. During normal one G flight, a portion of the main rotor thrust balances the tail rotor thrust and counteracts this right roll tendency. During low G flight, however, main rotor thrust is greatly reduced while the tail rotor thrust remains high, thus, a right roll can develop during low G maneuvers. Instinctive pilot reaction is to correct the roll with left lateral cyclic. But since main rotor thrust has been greatly reduced, lateral cyclic effectiveness is also greatly reduced. Left cyclic application may also result in mast bumping. Aft cyclic will quickly increase rotor thrust (higher G) and will return lateral cyclic effectiveness.

Because of mission requirements, it may be necessary to rapidly lower the nose to (1) acquire a target, (2) stay on target or, (3) recover from a pullup. At moderate to high airspeeds, fairly small abrupt forward cyclic inputs can yield G levels near zero. The helicopter may roll to the right simultaneously with forward cyclic, the roll being greater as G levels approach zero and when the roll SCAS is disengaged. If an abrupt right roll should occur when rapidly lowering the nose, pull in aft cyclic to stop the roll and effect recovery. Left lateral cyclic will not effect recovery from a well developed right roll during the flight below 1 G and may cause mast bumping. Do not engage/disengage SCAS during recovery. When it is necessary to rapidly lower the nose, it is essential that the pilot monitor changes in roll attitude as the cyclic is moved forward.

Should an uncommanded right roll occur during flight below one G, the following procedures are recommended:

1. Cyclic — Immediately center lateral, then aft.

When main rotor returns to normal thrust conditions:

2. Controls — As required to regain balanced flight.

If mast bumping occurred or was suspected:

3. Land as soon as possible.

WARNING

Should flight conditions occur in which the above procedures are impractical (i.e., nose extremely high at low airspeed), use pedals to yaw aircraft into nose low dive. Up collective can also be used when power available permits. Do not engage/disengage SCAS during recovery.

Mast Bumping.

Mast bumping occurs when the rotor exceeds its critical flapping angle and the underside of the rotor hub contacts (bumps) the rotor mast. If contact is severe, mast deformation can occur and cause mast structural failure. Excessive rotor flapping can also cause rotor blade contact with the tailboom or cockpit. Mast bumping generally occurs at, but is not restricted to, the extremes of the operating envelope. The most influential causes are (in order of importance):

1. Low G maneuvers (below plus 0.5 G).
2. Abrupt roll reversals (larger flapping occurs during left to right reversals).
3. Rapid large cyclic motion (especially forward cyclic).
4. Flight near longitudinal/lateral CG limits.
5. High slope landings.

Less significant causes are maximum sideward/rearward flight, sideslip, and bladestall conditions.

WARNING

Should mast bumping occur in flight, catastrophic results are highly probable. Since conditions causing rotor flapping are cumulative, improper pilot response/recovery techniques to flight situations approaching or favorable to mast bumping can aggravate the situation and lead to in-flight mast bumping and mast separation.

Favorable conditions and recommended recovery procedures for mast bumping are provided below.

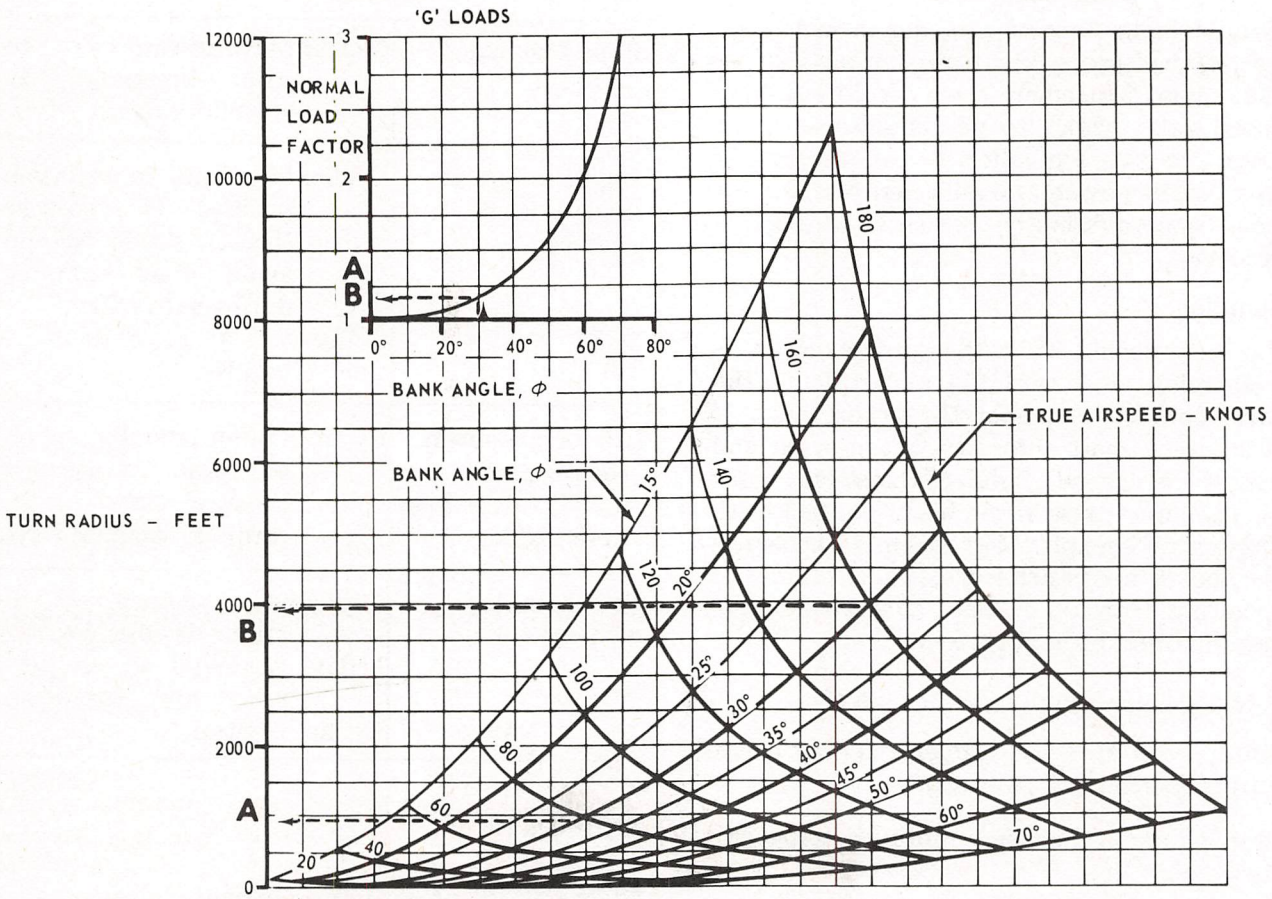
CONDITION	RECOVERY TECHNIQUE
Start/Shutdown	Cyclic: Move to stop bumping.
Rear/Side Flight	Cyclic: Move slightly toward center. Pedal: Bring nose into wind.
Slope Landing	Cyclic: Move toward center to stop bumping, re-establish hover.
Engine failure at high forward airspeed	Cyclic: Move aft to maintain positive G (positive thrust), retain Nr and avoid mast bumping during auto entry. Collective: As req'd to maintain Nr.
Low G maneuvers (below plus 0.5 G) (other than nose high)	Cyclic: Center laterally and aft to regain positive G (positive thrust) on the rotor & maintain Nr.
Nose high, low airspeed	Collective: Judiciously increase, if possible. Pedal: As req'd to establish nose low condition. Cyclic: Neutral.

Diving Flight.

Diving flight presents no particular problems in the AH-1T (TOW); however, the pilot should have a good understanding of such things as rates of descent versus airspeed, rate of closure and rates of descent versus power. Because of relatively low drag, the helicopter gains airspeed quite rapidly in a dive and it is fairly easy to exceed the redline. Rates of descent over 3000 ft./min. are not uncommon during high speed dives. These high rates of descent coupled with the high flight path speeds (290 ft./sec. at 170 KIAS) require that the pilot monitor both rate of closure and terrain features very closely and plan his dive recovery in time to avoid having to make an abrupt recovery. If an abrupt recovery is attempted at speeds near redline airspeed, "mushing" of the helicopter can occur. If mushing is experienced, do not increase collective. Application of increased collective will aggravate condition.

$$\text{TURN RADIUS} = \frac{v^2}{g \tan \phi} \qquad \text{NORMAL LOAD FACTOR} = \frac{1}{\cos \phi}$$

Note This chart gives the turn radius in feet as a function of airspeed and either bank angle or normal load factor. The capability of the aircraft is not inferred by this chart, but trade-off of bank angle versus turn radius are valid.



EXAMPLE **A**

AIRSPEED – 80 KTAS
BANK ANGLE – 30 DEGREES

SOLUTION:
TURN RADIUS – 981 FEET
'G' LOAD – 1.15

EXAMPLE **B**

AIRSPEED – 160 KTAS
BANK ANGLE – 30 DEGREES

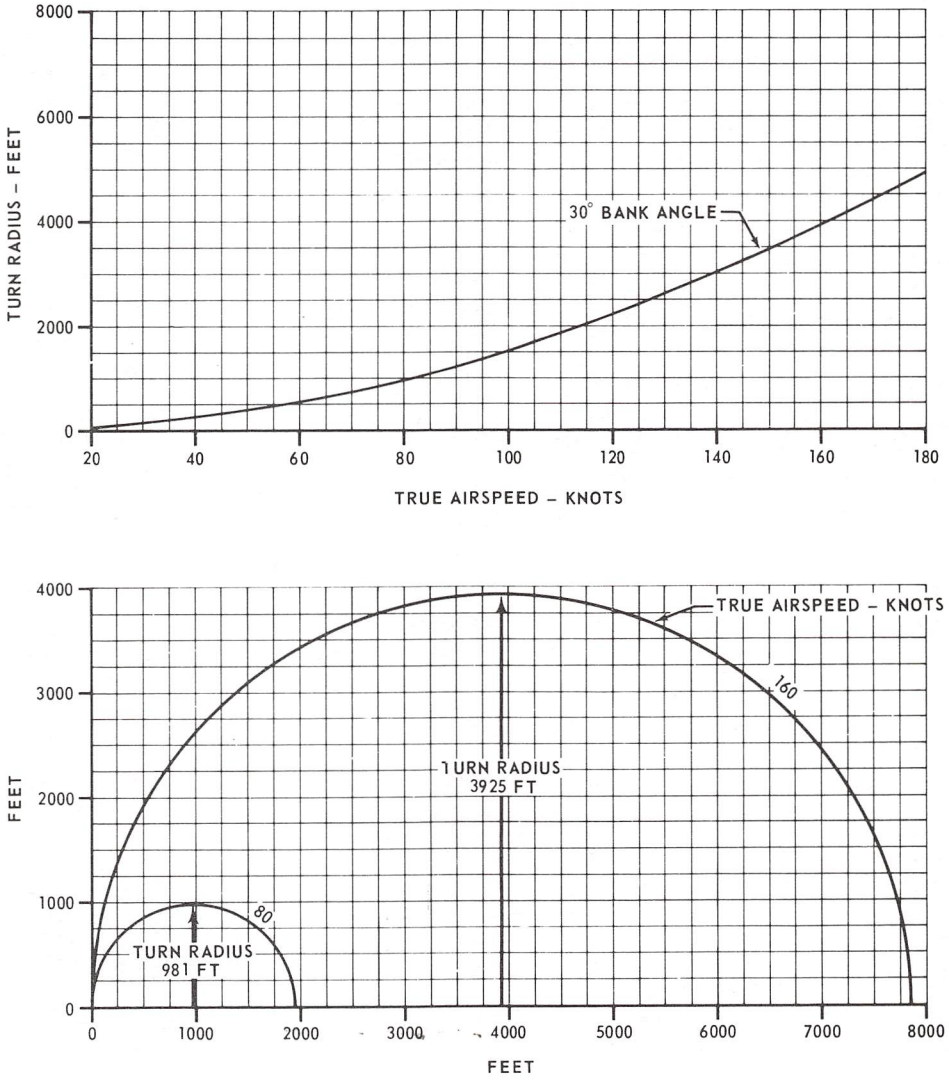
SOLUTION:
TURN RADIUS – 3925 FEET
'G' LOAD – 1.15

209960-31

Figure 4-1. Radius of Turn

Note

This chart gives the turn radius in feet as a function of airspeed and either bank angle or normal load factor. The capability of the aircraft is not inferred by this chart, but trade-off of bank angle versus turn radius are valid.



209900-30

Figure 4-2. Radius of Turn — 30 Degree Bank

POWER DIVES.

At speeds above the maximum level flight speed, the rate of descent will increase approximately 1000 ft./min. for every 10 knots increase in airspeed for the full power condition.

HOVERING CAPABILITY.

Hovering capability is affected by in-ground-effect (IGE), out-of-ground effect (OGE), outside air temperature (OAT), pressure altitude, wind speed, engine torque (power available), and gross weight of the helicopter. Hovering IGE performance is better than OGE because during IGE the rotor sets up a current flow between the helicopter and the ground, providing a cushion of air to partially support the helicopter weight. Temperature variations affect engine and rotor performance. Hovering with heavier gross weights or at higher altitudes is possible with lower temperatures and higher wind velocities. Lower temperatures increase engine efficiency and wind represents airspeed; therefore, either condition or both, will increase hovering performance due to the ability of the main rotor to provide more lift.

DYNAMIC ROLLOVER CHARACTERISTICS.

During normal takeoffs and landings, slope takeoffs, and landings, or landings and take-offs with some bank angle or side drift, the bank angle or side drift can cause the helicopter to get into the situation where it is pivoting about a skid. When this happens, lateral cyclic control response is more sluggish and less effective than for the free hovering helicopter. Consequently, if the bank angle (the angle between the aircraft and the horizon) is allowed to build up past 15°, the helicopter will enter a rolling maneuver that cannot be corrected with a full cyclic and the helicopter will roll over on its side. In addition, as the roll rate and acceleration of the rolling motion increases, the angle at which recovery is still possible is significantly reduced. The critical roll over angle is also reduced for a right skid down condition, crosswinds, lateral center of gravity offset and left rudder pedals inputs.

When performing maneuvers with one skid on the ground, care must be taken to keep the aircraft trimmed, especially laterally. For example, if a slow takeoff is attempted and the tail rotor thrust contribution to rolling moment is not trimmed out with cyclic, the critical recovery angle will be exceeded in less than 2 seconds. Control can be maintained if the pilot maintains trim, does not allow aircraft rates to become large, and keeps the bank angle from getting too large. The pilot must fly the aircraft into the air smoothly keeping executions in pitch, roll and yaw low and not allowing any untrimmed moments.

When performing slope take-off and landing maneuvers, follow the published procedures, being careful to keep roll rates small. Slowly raise the down slope skid to bring the aircraft level and then lift off. (If landing, land on one skid and slowly lower the down slope skid). If the aircraft rolls to the up slope side (5° to 8°), reduce collective to correct the bank angle and return to wings level and then start the take-off procedure again.

Collective is much more effective in controlling the rolling motion than lateral cyclic because it reduces the main rotor thrust. A smooth, moderate collective reduction of less than approximately 40% (at a rate less than approximately full up to full down in 2 seconds) is adequate to stop the rolling motion with about 2 degrees bank angle overshoot from where down collective is applied. Care must be taken to not dump collective at too high a rate as to cause fuselage-rotor blade contact. Additionally, if the helicopter is on a slope and the roll starts to the up slope side, reducing collective too fast creates a high rate in the opposite direction. When the low slope skid hits the ground, the dynamics of the motion can cause the aircraft to roll about down slope skid and over on its side. Do not pull collective suddenly to get airborne as a large and abrupt rolling moment in the opposite direction will result. This moment may be uncontrollable.

WARNING

If the aircraft reaches 15° of bank angle with one skid on the ground and thrust approximately equal to the weight, the aircraft will roll over on its side. Reduce collective to stop the roll and correct the bank angle to wings level.

CAUTION

When landing or taking off, with thrust approximately equal to the weight and one skid on the ground, keep the aircraft trimmed and do not allow aircraft rates to build up. Fly the aircraft smoothly off (or onto) the ground, carefully maintaining trim.

PYLON ROCK.

The AH-1T (TOW) is not subject to pylon rock under normal conditions. Pylon rock is the phenomenon of the helicopter pylon moving periodically (½ per Rev or 2.7 cps). This pylon motion is commonly noted by several short self-damping oscillations with the number of perceptible oscillations indicative of the state of wear of pylon dampers.

If pylon rock is encountered, a change of flight condition, preferably by lowering the collective, should eliminate the motion.

POWER SETTLING.

Power Settling is most likely to occur during conditions of high gross weight, high density altitude, low airspeed and descending powered flight. Under these conditions a helicopter is settling through the air displaced by its own rotor system. The downwash then recirculates through the helicopter rotor system, resulting in reduction of lift, increased roughness and poor control response.

Power settling is an uncommanded rate of descent caused by the helicopter rotor encountering the "vortex ring state" as it settles into its own downwash. In this state the flow through the rotor system is upward near the center of the rotor disc and downward in the outer portion. This results in zero net thrust from the rotor and extremely high aircraft descent rates. Power settling is not restricted to high gross weights or high density altitudes. It may not be recognized, and a recovery effected, until considerable altitude has been lost. Helicopter rotor theory indicates that it is most likely to occur when descent rates exceed 800 FMP during (1) vertical descents initiated from a hover and (2) steep approaches at less than 40 knots.

Indications to the pilot are:

1. Rapid descent rate increase.
2. Increase in overall vibration level.
3. Loss of control effectiveness.

Recovery by:

1. Forward cyclic to gain airspeed.
2. Descrease collective.

WARNING

Increasing collective has no effect toward recovery and will aggravate power settling. During approaches at less than 40 knots, avoid descent rates exceeding 800 FPM.

ROTOR DROOP.

Droop is a term used to denote a change in power turbine speed (Nf) and rotor speed that occurs with a demand for increased power with the governor at a constant speed setting. Droop may be further categorized as either transient or steady state. Transient droop is the momentary change in power turbine speed and rotor speed resulting from an increased power demand, and it is compensated for by the Nf governor. Steady state droop is the decrease in power turbine speed and rotor speed which results from an increased power demand (stabilized condition) and it is not compensated for by the Nf governor control.

VIBRATION IDENTIFICATION.

One/Rev Vibration (Main Rotor).

This vibration is relatively easy to recognize in that it is quite easy to count (approximately 5/sec.). The following are normal causes of 1/rev vibration:

1. Rotor out of balance condition causes a lateral 1/rev. vibration. The rotor can be out of balance either chordwise or spanwise. An out-of-balance condition can appear as a vertical vibration during forward flight. Therefore, it is best to balance the rotor before attempting to analyze other 1/rev. vibrations. Consult the MIMs for corrective action.
2. Rotor out of track condition causes a vertical vibration and will normally increase in amplitude with airspeed. Appropriate corrective action is outlined in the MIMs.
3. Binding in the scissor links or mixing levers.
4. Binding in rotor grip bearings.

Low Frequency Vibration (Pylon Rock).

This vibration manifests itself as a vertical vibration (about 3/sec). It is more noticeable at low airspeeds and high power, at forward cg. This "Rocking Chair" motion can usually be reduced by reducing speed and

power. It is the result of the pylon mounts either having failed or deteriorated. It can also be induced by erratic cyclic motion.

Two/Rev Vibration.

This vibration (10/sec) is extremely difficult to count. Amplitude increases with airspeed as a result of unequal drag causing the top of the mast to move in a manner to shake the pylon at 2/rev frequency. This can be caused by soft pylon mounts, although a certain amount of 2/rev is inherent in the helicopter.

1. Check pylon mounts for separation or bottoming out.
2. Check drag braces of the rotor to see that they are mounted securely and have no play in attachment points.
3. Tailboom attachment bolts.

High Frequency Vibration.

High frequency vibrations are much too fast to count and feel like a "buzz". These frequencies may emanate from the engine, improper driveshaft alignment, couplings improperly functioning, bearings dry or excessively worn, or tail rotor out of track or balance. If excessive high frequency vibration exists, it is recommended that the helicopter land and a crew member attempt to locate the source. The area where the highest amplitude of the vibration exists is generally the area from which the vibration is originating.

AUTOROTATION CHARACTERISTICS

Due to the wide speed range capability of the AH-1T (TOW), some discussion of the POWER OFF characteristics of the rotor system is essential.

Main Rotor.

The following steps explain the necessity of maintaining rotor rpm in its normal power off range (91 to 105 percent).

Normal Rotor Speed.

The normal rotor speed assures the pilot that he will retain adequate control effectiveness. Low rpm (underspeed) causes a proportional loss of response to control inputs. High rpm (overspeed) can cause structural damage to the rotor system.

Rotor Flapping.

The angle between the tip path plane and the mast increases at low rpm. By maintaining rotor rpm in the normal range, the pilot assures safe clearance between the rotor and the tailboom.

Rotor Inertia.

Rotor inertia is a characteristic which tends to prolong the effectiveness of collective control in the autorotation landing. This effectiveness decreases with rpm. Normal rotor rpm assures the pilot that he will have normal inertia and normal collective control response with which to arrest the sink rate in the autorotation landing.

Rotor RPM.

The following steps list the factors which affect power-off rotor rpm.

AIRSPEED.

In autorotation, rotor rpm varies with airspeed. Maximum rotor rpm is achieved at a steady state of 60 to 80 KIAS (Figure 4-3). Rotor rpm decreases at stabilized airspeeds above or below 60 to 80 KIAS range. When changing airspeeds, cyclic movement will produce a rotor rpm other than that produced under steady state conditions as follows:

FROM LOW AIRSPEED. Example: From a stabilized 30 KIAS autorotative condition, a positive forward cyclic movement to increase airspeed will cause the rotor rpm to decrease initially and then increase when the helicopter is stabilized at the higher speed.

FROM HIGH AIRSPEED. Example: From a stabilized 120 KIAS autorotative condition, a positive aft cyclic movement to decrease airspeed will cause the rotor rpm to increase initially and decrease when the helicopter is stabilized at the lower speed.

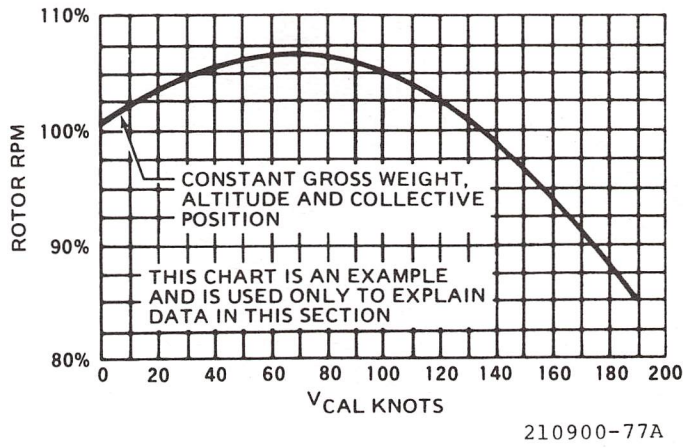


Figure 4-3. Autorotation RPM Versus Airspeed

NOTE

The maximum permissible steady state autorotation airspeed is 120 KIAS.

GROSS WEIGHT.

The power-off rpm varies significantly with gross weight for identical collective settings. A low gross weight will produce a low rotor rpm. A high gross weight will produce a high rotor rpm. With the collective system correctly rigged to a minimum blade angle (full down collective stick) of approximately 6.75 degrees the pilot must manually control rpm with collective stick in order to prevent overspeeding of the rotor when at high gross weight.

DENSITY ALTITUDE.

The power-off rotor rpm varies with altitude; low altitude — low rpm; high altitude — high rpm. The pilot will find that the higher the altitude — the higher the collective stick position required to prevent overspeed of the rotor.

CYCLIC FLARE.

Aft cyclic control application (nose up pitching) produces an increase in rotor rpm proportional to the flare and entry speed. The higher the speed — greater the flare effectiveness. From a high speed entry condition, a steep flare can produce an overspeed unless limited by collective pitch control.

Pilot Technique.

It can be readily seen from the information, that the pilot technique must vary in accordance with the actual conditions of airspeed, altitude, and gross weight at the time of engine failure.

SECTION V — EMERGENCY PROCEDURES

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INTRODUCTION.

Emergency Procedures.

Emergency procedures are divided into two categories, critical and non-critical. The critical items are those which must be performed immediately if the emergency is not to be aggravated. These critical items are underlined and must be performed immediately in proper sequence. Non-critical emergency procedure actions are those that contribute to an orderly sequence of events and assure that all necessary actions are taken. These procedures are accomplished with direct reference to the checklist.

Scope.

The following procedures contain the indications of failures or malfunctions which affect safety of the crew, the helicopter, ground personnel or property; the use of emergency features of primary and back-up systems; and appropriate warnings, cautions, and explanatory notes.

Special Instructions.

1. The following terms indicate the degree of urgency in landing the helicopter.

Land immediately	Self-explanatory. Landing in trees, water or otherwise unsafe areas should be considered as a last resort.
Land as soon as possible	Land at first site of which a safe landing is reasonably assured.

Land as soon as practical - Extended flight is not recommended, and landing site and duration of flight are at the discretion of the pilot.

2. The following terms are used to describe the operating condition of a system, subsystem, assembly or component.

Affected - fails to operate in the normal or usual manner.

Normal - operates in the normal or usual manner.

3. The master caution light will illuminate when any caution panel light illuminates. When caution and warning lights are illuminated, accomplish the actions and procedures as follows:

*Only on pilot panel
**Segments aviation green

ADVISORY CAUTION AND WARNING LIGHT — INITIAL ACTION

PANEL WORDING	CONDITION	CORRECTIVE ACTION
OIL PRESS (engine #1, engine #2)	Respective engine oil pressure below operating minimum (40 psi).	Check engine oil pressure to verify low indication. If below limit, shut down respective engine. Land as soon as practical.
CHIP DETR (engine #1, engine #2)	Metal particles in respective engine.	Flight idle. Check oil pressure and temperature. If normal operate at reduced power. If pressure is low and/or temperature is high, shut down respective engine. Land as soon as practical.
FUEL FILTER (engine #1, engine #2)	Fuel filter partially obstructed.	Prepare for single engine failure. Land as soon as practical.
*PART SEP OFF	Particle separator door not full open (respective engine).	Check switch position — OFF or AUTO. Verify engine rpm. Avoid continued operation in icing or engine eroding environment.
NO. 1 — 2 DC GEN	Respective dc generator failed.	GEN-RESET, then ON. If DC GEN light remains illuminated, GEN — OFF.

ADVISORY CAUTION AND WARNING LIGHT — INITIAL ACTION (Cont'd.)

PANEL WORDING	FAULT CONDITION	CORRECTIVE ACTION
* 90°TEMP/PRESS	OIL TEMP above limits and/or OIL PRESS below operating minimum.	Land as soon as possible.
*42° TEMP/PRESS	OIL TEMP above limits and/or OIL PRESS below operating minimum.	Land as soon as possible.
XMSN CHIP DETR	Particles in transmission.	Power 75% or less. Land as soon as possible. If XMSN OIL HOT OR XMSN OIL PRESS light illuminates, reduce power to 60% or less. Refer to Impending XMSN Failure. NEW
C BOX CHIP DETR	Metal particles in combining gearbox.	Reduce power. Land as soon as possible.
90° CHIP DETR	Metal particles in 90° gearbox.	Reduce tail rotor power. Land as soon as practical.
42° CHIP DETR	Metal particles in 42° gearbox.	Reduce tail rotor power. Land as soon as practical.
XMSN OIL HOT	Oil overtemperature (above 110°C).	Verify oil temperature. Reduce power. Land as soon as possible. Refer to Impending XMSN Failure. NEW
XMSN OIL PRESS	Oil pressure below operating minimum (30 psi).	Verify oil pressure. Reduce power to 60% or less. Land as soon as possible. Refer to Impending XMSN Failure. NEW
C BOX OIL PRESS	Oil pressure below operating minimum (40 psi).	Verify oil pressure. Reduce power. Land as soon as possible.
C BOX OIL HOT	Oil overtemperature (above 116°C).	Verify oil temperature. Reduce power. Land as soon as possible.
NO. 1 HYD PRESS NO. 2 HYD PRESS	Respective hydraulic system below operating minimum (below 2200 psi).	Check pressure. If pressure is low, shut off affected system. Land as soon as possible.
NO. 1 HYD TEMP NO. 2 HYD TEMP	Respective system oil overtemperature.	Shut off affected system. Land as soon as possible.

ADVISORY CAUTION AND WARNING LIGHT — INITIAL ACTION (Cont'd.)

PANEL WORDING	CONDITION	CORRECTIVE ACTION
* BATTERY TEMP	Battery overheating.	Turn off BATTERY Land as soon as possible.
* XMSN OIL BYP	Oil bypassing cooler.	Reduce power to 60% or less. Land as soon as possible. Refer to Impending XMSN Failure.
AC MAIN	Main inverter failure.	INVERTERS — MAIN, check circuit breaker In. If inverter is still inoperative, INVERTERS — STBY. Turn off all non-critical ac equipment.
AC STBY	Stand-by inverter failure.	INVERTERS — STBY, check circuit breaker In.
FWD-AFT FUEL LOW	Respective fuel cell quanity low.	CROSSFEED — OPEN. Land as soon as possible.
*FWD-AFT FUEL BOOST	Fuel boost pump pressure low (below 5 psi).	CROSSFEED — OPEN. Pull respective circuit breakers.
**ENG 1-2 GOV MAN	Respective engine governor operating in manual mode.	Pilot controls engine rpm with twist grip throttle.
*AMMO DOOR OPEN **	Ammunition compartment door open.	Close door.
*ALT ENCODER **	Electrical power lost to altimeter encoder. If AAU-32/A not installed.	None
*EXT PWR DOOR OPEN	External power door open.	Close door.
**IFF	KIT-1A T/SEC ZEROIZED.	Check IFF switches and circuit breaker.
FIRE 1 PULL	Fire in engine No. 1.	Pull handle/FIRE EXT switch. MAIN. Shut down engine. Select RESERVE if required. Land as soon as possible.
FIRE 2 PULL	Fire in engine No. 2.	Pull handle/FIRE EXT switch. MAIN. Shut down engine. Select RESERVE if required. Land as soon as possible.

ADVISORY CAUTION AND WARNING LIGHT — INITIAL ACTION (Cont'd.)

PANEL WORDING	CONDITION	CORRECTIVE ACTION
*ROTOR BRAKE	Rotor brake engaged.	Place rotor brake handle down. If light remains illuminated, shut off hydraulic system # 2. If light does not extinguish, land as soon as possible.
MASTER CAUTION	Segment in caution panel illuminated.	Check caution panel.
RPM	Rotor rpm high, low, or engine rpm low.	Check triple tachometer and correct rpm as as required.

PART 1 — GROUND EMERGENCIES

EMERGENCY EGRESS AND RESCUE.

Pilot and copilot/gunner access is provided by canopy doors that are hinged at the top and swing outward and up. Both doors can be opened or closed either manually or electrically from inside or outside. Emergency exit or entrance is provided by a det cord system to cut the windows from the canopy support structure. The linear explosive system is installed around both canopy doors and around the windows on each side. Interconnecting lines of flexible detonating cord connect the linear explosive system with the three canopy jettison handles. The canopy jettison handles are located on the left side of the pilot glare shield, the copilot/gunner right console, and one is installed in the nose of the helicopter for ground rescue personnel. The system can be actuated from any of the canopy jettison handles (figure 5-1).

Emergency Egress.

1. Lap belt/shoulder harness release — OPEN.
2. Helmet — DISCONNECT (HSS/ICS). NEW
3. Canopy door handle — ROTATE (upward).
4. Manual clutch release — PUSH.
5. Helicopter — EXIT.

If canopy door cannot be opened manually:

1. Canopy jettison handle — ROTATE (90 degrees counterclockwise) and PULL.

WARNING

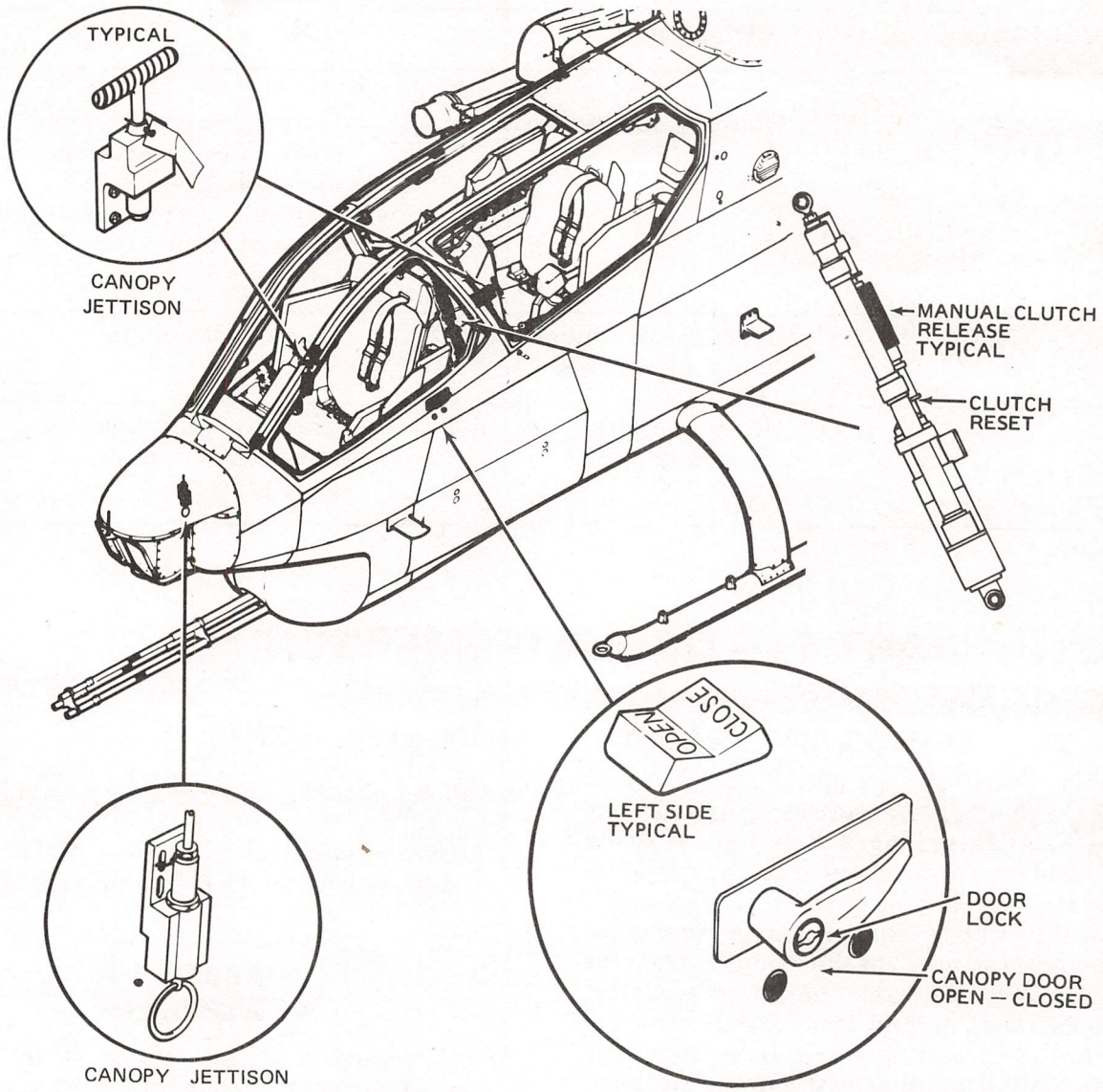
Personnel positioned within 50 feet of the helicopter could be injured by debris.

2. Helicopter — EXIT.

Rescue.

To open canopy and remove occupants:

1. Canopy door handles — ROTATE (downward).
2. Lap belt/shoulder harness — RELEASE.
3. Helmet — DISCONNECT (HSS/ICS). NEW
4. Occupants — REMOVE.



NOMENCLATURE	FUNCTION
CANOPY JETTISON	Removes glass from doors and windows.
DOOR ACTUATOR	Position door.
DOOR HANDLE	Latches door in closed position and deactivates electrical circuit.
DOOR SWITCHES	Opens or closes door electrically.
DOOR LOCK	Secure helicopter doors.
MANUAL CLUTCH RELEASE	Releases clutch for manual operation of door.
CLUTCH RESET	Sets clutch for electrical operation of door.

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Fig. 5-1. Emergency Egress and Rescue

If canopy doors cannot be opened manually:

1. External canopy jettison handle access door — PULL.
2. Handle ROTATE (90 degrees counterclockwise) and PULL.

WARNING

Personnel positioned within 50 feet of helicopter could be injured by debris.

3. Occupants — REMOVE.

HOT START.

Indications (affected engine).

1. INLET TEMP exceeds 900 degrees C for 2 seconds, or
2. INLET TEMP exceeds 1150 degrees C.

Procedure.

1. Throttle — CLOSE.
2. FUEL — OFF.
3. START — ENERGIZE (for 30 seconds or until INLET TEMP is below 300 degrees C).
4. Helicopter — SHUTDOWN.
5. Helicopter — EXIT.

ENGINE FIRE ON START (EXTERNAL).

Indications.

1. FIRE PULL warning light.
2. Smoke.
3. Fire.

Procedure.

1. Throttles — OFF.
2. START — OFF.
3. FIRE PULL handle (affected engine) — PULL.
4. FIRE EXT — MAIN/RESERVE.
5. Helicopter — SHUTDOWN.
6. Helicopter — EXIT.

PART 2 — TAKEOFF EMERGENCIES

SINGLE ENGINE FAILURE DURING TAKEOFF.

Indications.

NEW
1. Left yaw.
2. RPM caution light.
3. MASTER CAUTION light.
4. Caution lights.
5. Rotor rpm decrease.
6. Engine instruments (affected engine) decrease.

Procedure.

Gross weight, temperature, altitude, and airspeed will determine if flight can be continued.

1. Collective — ADJUST (To maintain rpm and desired power.)
2. Wing stores — JETTISON (as appropriate).
3. RPM — FULL INCREASE.

If insufficient altitude exists to continue flight:

1. Ground speed — DECREASE.

2. Landing attitude — ASSUME.

3. Collective — INCREASE (just prior to ground contact to cushion landing).

4. Helicopter — SHUTDOWN.

If altitude permits, adjust airspeed for maximum rate of climb or minimum rate of descent. After gaining sufficient altitude or establishing minimum rate of descent:

1. Affected engine — SECURE.

2. MASTER CAUTION light — RESET.

NEW 3. LAND AS SOON AS POSSIBLE.

DUAL ENGINE FAILURE DURING TAKEOFF.

Indications.

1. Rapid settling.

2. Both engines instruments decrease.

3. Left yaw.

4. RPM caution light and audio.

5. MASTER CAUTION light.

6. ROTOR RPM decrease.

7. Caution lights.

Procedure.

When two-engine failure is experienced:

1. Autorotation — ESTABLISH.

NOTE

Gross weight, temperature, altitude, and airspeed will determine if autorotation can be established.

CAUTION

Ground contact should be in a level attitude to minimize helicopter damage.

WARNING

The rotor brake should be applied to stop the rotor prior to crew exiting the helicopter.

PART 3 — INFLIGHT EMERGENCIES

HYDRAULIC MALFUNCTIONS.

Hydraulic System No. 1 Failure.

Indications.

1. Grinding or howling noise from pump.

2. Fluctuating or low hydraulic system pressure.

3. MASTER CAUTION light.

4. No. 1 HYD PRESS caution light.

5. High tail rotor pedal force.

6. YAW SCAS disengaged.

CAUTION

Cyclic and collective rate limiting and/or control feedback may be evident during abrupt maneuvers.

Procedure.

1. SCAS (YAW channel) — OFF.
2. HYD — SYS 1 OFF.
3. HYDR CONT circuit breaker — IN.
4. MASTER CAUTION light — RESET.
5. LAND AS SOON AS POSSIBLE.

Hydraulic System No. 2 Failure.

Indications.

1. Grinding or howling noise from pump.
2. Fluctuating or low hydraulic system pressure.
3. MASTER CAUTION light.
4. NO. 2 HYD PRESS caution light.
5. PITCH and ROLL SCAS disengaged.

CAUTION

Cyclic and collective rate limiting and/or control feedback may be evident during abrupt maneuvers.

Procedure.

1. SCAS (PITCH and ROLL channels) — OFF.
2. HYD — SYS 2 OFF.
3. HYD CONT circuit breaker — IN.
4. MASTER CAUTION light — RESET.
5. LAND AS SOON AS POSSIBLE.

Hydraulic Actuator/Servo Malfunctions.

The hydraulic system consists of two completely independent power control subsystems. If an actuator servo valve becomes inoperative, such as foreign material causing a valve to jam, the emergency servo valve bypass is actuated through pilot control inputs to maintain hydraulic powered flight control. However, the pilot control force required to accomplish the bypass operation in the affected actuator will be higher than normal and should cue the pilot that a hydraulic malfunction has occurred. This increase in force will be noted only in the control axis powered by the malfunctioning actuator. Hydraulic system pressure will remain normal, but a system operating in the bypass mode may cause overheating and overtemperature condition in the affected system (Hydraulic System 1 or System 2). This malfunction should be treated as an individual system failure and the pilot should follow the procedure for a single hydraulic system failure.

If a HYD TEMP caution light is illuminated and prolonged operation is necessary to reach a safe landing area, the affected system should be turned off to prevent further overheating; the system could then be turned on again for the short period of time for the landing procedure.

Indications.

NEW

1. Erratic control inputs.
2. Intermittent uncalled-for control inputs.
3. Abnormally high control force in a single axis.
4. MASTER CAUTION light.
5. HYD TEMP caution light.

Procedure.

1. SCAS — OFF.
2. MASTER CAUTION light — RESET.
3. LAND AS SOON AS POSSIBLE (sliding landing).

Complete (Dual) Loss of Flight Control Hydraulic Boost (System 1 and System 2).

A safe recovery and landing from this type of malfunction can be achieved provided the following favorable conditions are satisfied:

1. Helicopter attitude control is maintained. Although flight control forces are manageable by single pilot effort, the transition from a power boosted to a non-power boosted flight control system could be critical if encountered during high performance maneuvers.

2. A suitable landing site is available; preferably a hard surfaced runway (at least 3000 feet) with a long, shallow approach capability.

Once stabilized helicopter attitude control is achieved, abrupt control movements or maneuvers should be avoided. Control movements will result in normal flight reactions in all respects except for the increased force required for the control movement. Flight control force characteristics are as follows:

FORE AND AFT CYCLIC.

Nose down (forward cyclic) stick force higher than nose up.

WARNING

Pitch rates in excess of 3 degrees/seconds should be avoided.

LATERAL CYCLIC.

Right roll force higher than left roll.

WARNING

Roll rates in excess of 3 degrees/seconds should be avoided.

PEDALS.

Left pedal force slightly higher than right. If a yaw oscillation develops, establish a steady state right side slip attitude (one half ball width right).

COLLECTIVE.

Collective travel may be restricted to (approximately) minimum of 30 percent torque and a maximum of 50 percent torque and will become increasingly difficult to move as each extreme of displacement is approached.

The airspeed should be adjusted to 100-120 KIAS for continued flight (return to base).

When landing without hydraulic boost, it is recommended that very shallow approach to a sliding landing be accomplished on a smooth, hard surface. The approach should be initiated from a straight-in position, 500 feet AGL or less, and 2 nmi from touchdown point. Ideally, the approach should be flown so as to touchdown at a minimum 20 KIAS with adequate margin for the landing slide and stop; the primary flight objectives will be to keep control movements to a minimum but still maintain the airspeed and sink rate that will terminate in a successful landing.

WARNING

At airspeeds below 20 KIAS cyclic feedback may be encountered. Do not attempt to dampen feedback.

NOTE

At light gross weight configurations the minimum power obtainable (approximately 30 percent torque) may not result in the desired sink rate unless airspeed is reduced below 35 KIAS. In this instance, a gross weight of 11,500 to 13,000 pounds would be desirable, so the decision to retain wing stores should be judiciously weighed in view of the possibility of the requirement to wave off the approach. Reduction of the throttles may be utilized to establish a rate of descent and minimize operation in the shaded area of the Height Velocity diagram.

WARNING

Throttles should be increased to 100% Nr prior to touchdown.

Indications.

1. MASTER CAUTION light.
2. HYD PRESS caution lights.
3. HYD PSI gages low.
4. All SCAS channels disengaged.
5. Increased control forces.

Procedure.

CAUTION

Avoid over-control and abrupt movements.

NEW 1. Airspeed — ADJUST (to 100 KIAS for continued flight).

2. SCAS (all channels) — CHECK OFF.

3. ENG RPM (N_f) — 100 PERCENT.

4. Wing stores — JETTISON (if necessary).

5. MASTER CAUTION light — RESET.

NOTE

Investigate collective limits.

6. Landing site — EVALUATE.

Ideally, a landing site with a hard surface and the capability for a long shallow approach should be selected. Initiate approach at approximately 2 nmi from touch-down point and at an altitude of not greater than 500 feet AGL.

7. Collective — DECREASE (to minimum obtainable).

8. Airspeed — ADJUST (to attain 300-500 fpm rate of descent).

CAUTION

At very low gross weight, it may be necessary to decrease airspeed to 35 KIAS or less to achieve 300-500 fpm rate of descent. In the airspeed range of 25-35 KIAS, it will be necessary to decrease airspeed to increase rate of descent. It will also be necessary to increase airspeed to decrease rate of descent.

NOTE

At high gross weights, the desired rate of descent should be easily attained within the obtainable power range.

Attitude should be maintained once a 300 — 500 fpm rate of descent is achieved. As the landing point is approached:

9. Rate of descent — MAINTAIN DESIRED RATE OF DESCENT WITH LONGITUDINAL CYCLIC.

Prior to touchdown:

10. ENG RPM (Nf) — 100 percent.

11. Sliding landing — EXECUTE.

WARNING

Rpm is necessary to maintain directional control during the landing slide. Rolling off throttles after touchdown will result in decrease of directional control.

CAUTION

Since it will not be possible to move the collective full down, the landing slide will be very long. In zero wind conditions it will be necessary to hold left cyclic during the slide in order to maintain lateral position.

12. Helicopter — SHUTDOWN. (Hold collective at minimum until rotor stops.)

Wave-off With Complete Hydraulic Failure.

1. ENG RPM (Nf) — 100 percent.

2. Power — INCREASE POWER (sufficiently to clear obstacles and obtain a positive rate of climb).

3. Airspeed — ADJUST TO 70 KNOTS MINIMUM.

SCAS FAILURE

Indications.

1. Reduction in helicopter stability in affected axis(es).
2. Increase in pilot workload to maintain desired attitude.
3. Larger attitude deviations than desirable with correction by the SCAS.

4. Erratic helicopter motion.

5. SCAS hardover will result in excessive roll, pitch and yaw rates separately or together.

Procedure.

1. SCAS (Affected Channels) — CHECK OFF.

NOTE

If the helicopter pitches, rolls, or yaws excessively without pilot input, maintain control of helicopter and disengage affected SCAS channel. If the SCAS is not disengaged, the possibility of the SCAS returning to the centered position coupled with the pilot input to stop the attitude excursion could result in an overcontrolled helicopter response in the opposite direction. When the affected SCAS channel is disenaged, the SCAS actuator will return to the centered position almost instantaneously; this coupled with a simultaneous pilot input to stop the attitude excursion could also result in an overcontrolled helicopter response in the opposite direction.

2. Airspeed — 100 KIAS.

3. LAND AS SOON AS PRACTICAL.

CONTROL SYSTEM MALFUNCTIONS.

Cyclic Control Interference.

Indications.

1. Stiffness or binding in control movement.

2. Restricted control travel.

Procedure.

1. Force trim — CHECK PROPER RELEASE.

2. Control movements — KEEP TO A MINIMUM.

3. LAND AS SOON AS PRACTICAL (Sliding Landing).

Collective Control Interference.

Indications.

1. Stiffness or binding in control movement.

2. Restricted control travel.

Procedure.

1. Control movements — KEEP TO MINIMUM.

2. LAND AS SOON AS PRACTICAL (Sliding Landing).

CAUTION

A shear pin is incorporated in the droop compensator linkage connection to the collective linkage. In case of a bind in the droop compensator linkage, the shear pin can be sheared to prevent binding of the collective control. The droop compensator is then inoperative and extreme care must be taken to prevent gas turbine overspeed and engine/rotor underspeed.

TAIL ROTOR MALFUNCTION.

There is no single emergency procedure for all types of anti-torque malfunctions. The key to a pilots successful handling of a tail rotor emergency lies is his ability to quickly recognize the type malfunction that has occurred.

Complete Loss of Tail Rotor Thrust.

This is a situation involving a break in the drive system, such as a severed driveshaft, wherein the tail rotor stops turning and no thrust is delivered by the tail rotor. A failure of this type in powered flight will always result in the nose of the helicopter swinging to the right (left sideslip) and usually a roll of the fuselage. Nose-down tucking will also be present. The most advisable procedure is to reduce power, to engine idle if necessary, and coordinate the resulting maneuver with cyclic control. At some gross weights it is possible that a stabilized powered flight condition can be achieved if the loss of the tail rotor thrust occurs at a high enough airspeed. Once stabilized in an autorotation, some power may be applied (altitude permitting) to see if powered flight is possible.

WARNING

For most gross weights, it is unlikely that the AH-1T can achieve a stabilized power flight condition following loss of tail rotor thrust. Emphasis should be placed on entering autorotation immediately by reducing collective and throttle setting. Control of heading will probably not be regained in autorotative flight. The pilot should expect that some rotation will be present until touchdown. Touchdown should be executed in as level an attitude as can be achieved. Ground speed should be as slow as possible to minimize the possibility of turnover.

Loss of Tail Rotor Components.

The loss of any tail rotor components will result in a forward CG shift. Other than additional nose-down tuck, this situation would be quite similar to complete loss of tail rotor thrust as discussed above.

Fixed Pitch Failures.

Failures of this type (broken control tubes, jammed slider, etc.) are characterized by either a lack of directional response when a pedal is pushed or the pedals in a locked position. If the pedals cannot be moved with a moderate amount of force, do not attempt to apply a maximum effort since a more serious malfunction could result. If the helicopter is in a trimmed condition when the malfunction is discovered, the engine power and airspeed should be noted and the helicopter flown to a suitable landing area. Combinations of engine torque, rotor rpm, and airspeed will correct or aggravate a yaw attitude and these are what will be used to land the helicopter.

LEFT PEDAL APPLIED.

If the tail rotor pitch becomes fixed during a high-power condition (left pedal applied), the helicopter will yaw to the left when power is reduced. Under these conditions, the power should be reapplied and airspeed adjusted to a value where a comfortable yaw angle can be maintained. If airspeed is increased, the vertical fin will become more effective and an increased left yaw attitude will develop. To accomplish landing, establish a power approach with sufficiently low airspeed (zero, if necessary) to attain a rate of descent with a comfortable side slip angle. As collective is increased just before touchdown, left yaw will be reduced.

NOTE

Use throttle, not RPM switch, for rpm control.

RIGHT PEDAL APPLIED.

If the tail rotor pitch becomes fixed during cruise flight or a reduced power situation occurs (right pedal applied) the helicopter will yaw to the right when power is increased. For either of these situations, a sliding landing can be performed. Throttles may be reduced as required when adding collective at touchdown and cushion the landing with collective. If the right yaw becomes excessive, roll on the throttles and initiate a wave off. The greatest problem is the compromise that may have to be made between rate of descent and yaw attitude since the collective (power) is the primary control for both of these parameters. Within reasonable limits, it is probably preferable to land hard with a zero yaw attitude than to make a soft landing while in a severe yaw attitude.

Emergency Procedure For Anti-Torque Malfunction While At A Hover.

1. In the event of complete loss of tail rotor thrust or loss of tail rotor components, close throttle and perform hovering autrotation.
2. In the event of loss of tail rotor pitch control, close throttle and perform hovering autorotation.
3. In the event of jammed tail rotor pitch control, gradually reduce collective pitch to accomplish a power touchdown.

MAST BUMPING

Indications:

1. Sharp two/rev knocking.

Procedure:

During high speed sideward and rearward flight: NEW

1. Cyclic — IMMEDIATELY APPLY SLIGHTLY TOWARD CENTER.

2. Pedals — IMMEDIATELY APPLY AS REQUIRED TO BRING NOSE INTO RELATIVE WIND.

3. LAND AS SOON AS POSSIBLE.

During all other flight conditions:

1. Cyclic — IMMEDIATELY CENTER LATERALLY, THEN AFT AS REQUIRED TO MAINTAIN POSITIVE G LOAD ON ROTOR.

2. Controls — AS REQUIRED TO REGAIN BALANCED FLIGHT.

3. LAND AS SOON AS POSSIBLE.

UNCOMMANDED RIGHT ROLL DURING FLIGHT BELOW 1 G.

Indications:

1. Uncommanded right roll.

2. Reduced cyclic effectiveness.

Procedure:

1. Cyclic — IMMEDIATELY CENTER LATERALLY, THEN AFT.

WARNING

Lateral cyclic* is decreasingly effective below 1 G and increases main rotor flapping which can result in mast bumping. Do not engage SCAS during recovery.

When main rotor returns to a positive thrust condition:

2. Controls — AS REQUIRED TO REGAIN BALANCED FLIGHT.

If mast bumping occurred:

3. LAND AS SOON AS POSSIBLE.

ENGINE MALFUNCTIONS.

Single Engine Failure (In Flight).

The pilot's reaction to the failure of a single engine encompasses two general areas; control of the helicopter and possible engine restart. In all cases, control of the helicopter, attitude, altitude and rotor rpm should take precedence over any attempt to restart a failed engine. Under high gross weight and density altitude conditions, level flight may not be possible. At maximum single engine power available, and at low AGL altitude, the external wing stores should be jettisoned to reduce gross weight so that level flight can be achieved. This should give the pilot sufficient time to analyze possible causes of the failure and make a decision whether or not to attempt an airstart. When one engine fails, rotor speed can be expected to droop. The desired rotor rpm can be regained if sufficient power is available, by using the engine RPM switch. After rpm is regained by use of the RPM switch, desired rotor rpm can be maintained by the collective control.

Indications.

1. Left yaw.

2. RPM caution light (gas producer).

3. MASTER CAUTION light.

4. Rotor rpm decrease.

5. Engine instruments decrease.

6. CAUTION panel lights.

Procedure.

1. Collective — ADJUST TO MINIMUM REQUIRED.

2. Wing stores — JETTISON (if appropriate).

   Under conditions of high gross weight or low altitude and low airspeed, strong consideration should be given to jettisoning of wing stores simultaneously with step 1.

3. RPM — FULL INCREASE.

4. ECU and RAIN RMV — OFF.

5. Failed engine — IDENTIFY.

6. Throttle failed engine — CLOSE.

7. FUEL failed engine — OFF.

8. GEN failed engine — OFF.

9. PART SEP (normal engine)— OFF.

10. MASTER CAUTION light — RESET.

11. If desired — AIRSTART.

NEW 12. LAND AS SOON AS POSSIBLE.

Airstart.

CAUTION

If the cause of failure is obviously mechanical as evidenced by abnormal, metallic, or grinding sounds, do not attempt an airstart.

1. Throttle (affected engine) — CLOSED.
2. GEN — OFF.
3. GOV — AS DESIRED.

NOTE

The decision concerning which portion of the fuel control to use must be made by the pilot based on his analysis of the engine failure and his own skill in flying with the manual fuel control.

4. FUEL — ON.
5. FUEL PRESS — NORMAL.
6. ENGINE OIL TEMP — INDICATES NORMAL OR LESS.

NOTE

- Energizing the starter generator on the failed engine will result in an increased power demand on the operating engine. Turning the operating starter generator off will alleviate the increase in power demand.
- Abnormal instrument readings of the failed engine may indicate that an airstart might be inadvisable. INLET TEMP of operating engine will rise when attempting airstart.

7. START — ON (affected engine).
8. Engine oil PRESS — POSITIVE INDICATION.
9. Throttle — (With INLET TEMP below 200°C and GAS PROD (Ng) at 12 percent or above) OPEN (engine idle).
10. INLET TEMP — MONITOR.
11. START — OFF (at 50 percent Ng).
12. ENGINE OIL — CHECK PRESSURE AND TEMPERATURE.
13. GEN — ON.
14. Throttle — INCREASE (to match engine torques).
15. LAND AS SOON AS PRACTICAL.

Engine Shutdown In Flight.

If an airstart is unsuccessful or not desired:

1. Throttle — CLOSE.
2. FUEL — OFF.
3. START — OFF.
4. GEN — OFF.
5. LAND AS SOON AS PRACTICAL.

Single Engine Failure (Hovering In-Ground Effect).

Indications.

Same as single engine failure in flight.

Procedure.

1. Heading and landing attitude — MAINTAIN.
2. Collective — ADJUST (to control rate of descent and cushion landing).

Single Engine Failure (Hovering Out-Of-Ground Effect).

Indications.

Same as single engine failure in flight.

Procedure.

1. Heading and attitude control — MAINTAIN.
2. Collective — ADJUST (to maintain rpm and desired power).

If insufficient power exists to fly away:

1. Attitude — ASSUME LAND ATTITUDE.
2. Collective — INCREASE (just prior to ground contact to cushion landing).

If altitude permits, adjust airspeed for maximum rate of climb or minimum rate of descent. After gaining sufficient altitude or establishing minimum rate of descent.

1. Affected engine — SHUTDOWN.
2. LAND AS SOON AS POSSIBLE.

Dual Engine Failure.

Under operational conditions, the altitude-airspeed combination for a safe autorotative landing is dependent upon many variables such as pilot capabilities, density altitude, helicopter gross weight, proximity of a suitable landing area, and wind direction and velocity in relation to flight path. This does not preclude operation in the shaded area of the height velocity diagram under emergency or pressing operational requirements. Immediately upon a two-engine failure, rotor rpm will decay and the nose of the helicopter will swing to the left. This is due to the loss in power and corresponding reduction in torque. Except in those instances when a two-engine failure is encountered in close proximity to the surface, it is mandatory that autorotation be established by immediately lowering the collective pitch to minimum.

Heading can be maintained by depressing the right pedal to decrease the tail rotor thrust. Autorotative rpm will vary with different ambient temperature, pressure altitude, increase in G loading, and gross weight conditions. High gross weights, increased G loads, and higher altitudes and temperature will cause increased rpm which can be controlled by increasing collective pitch. Any increase of rotor rpm, other than specified for maximum glide, will result in a greater rate-of-descent. Therefore, if time permits, adjusting the collective pitch lever to produce the desired rotor rpm will result in an extended glide. At an altitude of approximately 75-100 feet, a flare should be established by moving the cyclic stick aft with no change in collective pitch. This will decrease both airspeed and rate-of-descent and cause an increase in rotor rpm. The amount that the rotor rpm will increase is dependent upon gross weight and the rate that the flare is executed. An increase is desirable because more energy will be available to the main rotor when collective pitch is applied.

DUAL ENGINE FAILURE IN FLIGHT.

Indications.

1. Rapid settling.
2. Both engines' instruments decrease.
3. Rotor rpm decreases.
4. Left yaw.
5. RPM caution light and audio.
6. MASTER CAUTION light.
7. CAUTION panel lights.

DUAL ENGINE FAILURE AT HIGH POWER AND HIGH AIRSPEED.

1. Cyclic — IMMEDIATELY AFT.

NOTE

The aft cyclic input will command a nose up attitude change, will initiate a flare to reduce airspeed and will maintain a rotor loading. If the aft cyclic command is not made, the aerodynamic loading will result in an uncommanded nose up pitch change. The SCAS will detect this as any other external disturbance, and will compensate with a nose down pitch correction.

2. Collective — DECREASE.

CAUTION

A SCAS nose-down pitch correction combining with rapid decrease of collective could cause less than +0.5 G loading resulting in excessive main rotor flapping and possible mast bumping.

3. Autorotation at (65-120 KIAS) — ESTABLISH.

DUAL ENGINE FAILURE AT LOW ALTITUDE.

ZERO TO 50 KIAS, 20 FEET ALTITUDE OR BELOW. From this condition of airspeed and low altitude, flare capability is limited and caution should be exercised to avoid striking the ground with the tail; the primary objective is to level the skids prior to ground contact. Initial collective reduction varies with altitude; from a 4-foot skid height, do not attempt collective reduction but use the available rotor energy and collective to cushion touchdown; above 4-foot skid heights, a partial reduction of collective will maintain rotor rpm until up collective is initiated to cushion touchdown.

50 TO 70 KIAS, 20 FEET ALTITUDE AND BELOW. From this condition flare capability is good. Initiate a cyclic flare and reduce collective to maintain rotor rpm, minimize rate of descent, and decelerate helicopter; level skids prior to ground contact and utilize collective to cushion touchdown.

NOTE

The optimum flare airspeed for all gross weights is 75 KIAS.

75 KIAS TO Vh AIRSPEED, 20 FEET ALTITUDE AND BELOW. Immediately execute a cyclic flare to initiate a climb to 25 feet or higher and lower collective as necessary to maintain rotor rpm; achieve 75 KIAS and maintain until normal flare and touchdown is accomplished.

Procedure.

1. Autorotation — ENTER IMMEDIATELY.

If conditions permit:

2. Airstart — ATTEMPT (on one or both engines).

If airstart is successful, follow procedures for single engine landing.

If airstart is unsuccessful, follow procedures for autorotative landing.

DUAL ENGINE FAILURE (HOVERING IN-GROUND EFFECT).

Indications.

Same as indications for Dual Engine Failure in Flight.

Procedure.

1. Directional pedals — MAINTAIN HEADING.
2. Attitude — LEVEL (to prevent adverse pitching on touchdown).
3. Collective — INCREASE (to cushion landing).

Upon touchdown:

4. Cyclic — CENTERED.
5. Collective — FULL DECREASE.
6. Rotor brake handle — ENGAGE.

CAUTION

Regardless of sink rate at touch-down, damage will be minimized when in a level attitude.

DUAL ENGINE FAILURE (HOVERING OUT-OF-GROUND EFFECT).

Indications.

Same as indications for Dual Engine Failure in Flight.

Procedures.

1. Collective — DECREASE (to maintain rotor rpm).
2. Directional pedals — MAINTAIN HEADING.
3. Attitude — LOWER NOSE TO INCREASE AIRSPEED (if possible).

NOTE

If altitude permits attempt to attain optimum autorotation flare airspeed.

Prior to touchdown.

4. Collective — INCREASE (to cushion landing).
5. Cyclic — AS REQUIRED (to level helicopter).

CAUTION

Regardless of sink rate at touchdown, damage will be minimized when in a level attitude.

Upon touchdown:

6. Collective — FULL DECREASE.
7. Rotor brake handle — ENGAGE.

Power Turbine Governor (NF) Failure.

Indications.

1. Erratic GAS PROD RPM (Ng).
2. Erratic INLET TEMP.
3. Fluctuating ENG RPM (Nf).
4. Abrupt increase in ENG RPM (Nf) above governed value.
5. Abrupt decrease in ENG RPM (Nf) below governed value.
6. Fluctuating TORQUE.

Procedure.

1. Affected engine — IDENTIFY.
2. Throttle — ENGINE IDLE.
3. GOV — MANUAL. (It is not necessary to wait for GAS PROD (Ng) to stabilize at engine idle before switching to manual.)

CAUTION

The engine being operated on manual fuel control shall be closely monitored to ensure limits are not exceeded.

4. Throttle — ADVANCE (slowly to desired power setting).
5. LAND AS SOON AS PRACTICAL.

Engine Underspeed Gas Prod (Ng).

Indications.

1. Abrupt decrease in GAS PROD (Ng).
2. Subsequent decrease in ENG RPM (Nf).
3. Possible decrease in ROTOR RPM (Nr).
4. Decrease in TORQUE (affected engine).

Procedure.

1. Collective — ADJUST (maintain 97 - 100% ROTOR RPM (Nr)).
2. Affected engine — IDENTIFY.
3. Throttle — ENGINE IDLE.
4. GOV — MANUAL.

CAUTION

The engine being operated on MANUAL fuel control shall be closely monitored to ensure that limits are not exceeded.

5. Throttle — ADVANCE (slowly to desired power setting).
6. LAND AS SOON AS PRACTICAL.

Engine Overspeed Rotor RPM (NR).

Indications.

1. Increase in ROTOR RPM.
2. Increase in ENG RPM (Nf) (affected engine).
3. Increase in GAS PROD RPM (Ng) (affected engine).
4. Increase in TORQUE (affected engine).

CAUTION

The increase in the above parameters of the affected engine may result in a corresponding decrease in these parameters on the normal engine. A cross check of both engines' gages will preclude a false diagnosis of a power loss of the engine not experiencing the overspeed.

Procedure.

1. Collective — ADJUST (to avoid overspeed).
2. Affected engine — IDENTIFY.
3. Throttle — ENGINE IDLE.
4. GOV — MANUAL.

CAUTION

The engine being operated on MANUAL fuel control shall be closely monitored to ensure that limits are not exceeded.

If unable to control engine, secure engine. If control is attained:

5. Throttle — ADVANCE (slowly to desired power setting).
6. LAND AS SOON AS PRACTICAL.

Engine Fire in Flight.

Indications.

1. Smoke.
2. Fumes.
3. Fire.
4. FIRE PULL warning lights.

Procedure.

NOTE

Fire may be confirmed by yawing the helicopter and observing the smoke trail.

1. Throttle — CLOSE.
2. FIRE PULL handle — PULL.
3. FIRE EXT — MAIN (if fire indications persists, switch extinguisher to RESERVE.). NEW
4. Single engine procedure — EXECUTE.
5. CROSSFEED — CLOSE.
6. FUEL BOOST circuit breaker — PULL.

NOTE

FUEL AFT BOOST circuit breaker shall be pulled for fire in No. 2 engine and FUEL FWD BOOST circuit breaker shall be pulled for fire in No. 1 engine. With cross feed valve closed and FUEL AFT BOOST circuit breaker pulled, there will be no indication of fuel pressure.

7. MAYDAY — BROADCAST.
8. LAND AS SOON AS POSSIBLE.
9. If fire persists — LAND IMMEDIATELY.

Fire-Both Engines In Flight.

In the event that both FIRE PULL warning lights illuminate simultaneously in flight, a decision must be made whether or not to terminate the subsequent approach with a full autorotational landing or with a power recovery and landing. This decision will be based on the length of time required to land the helicopter; i.e., the extent to which the fire will spread prior to landing. At higher altitudes, it may be necessary to secure both engines in order to extinguish the fire before incurring catastrophic damage. At lower altitudes, it may be more prudent to land with power (on at least one engine) in order to increase the probability of a safe landing. In any event, an immediate landing must be made, and the ultimate decision on how far to proceed beyond Step 1 (below) must be based on altitude and rests with the pilot in command.

Indications.

1. Smoke.
2. Fumes.

3. Fire.

4. FIRE PULL warning lights.

Procedure.

1. Autorotation — ENTER.
2. Throttles — CLOSE.
3. FIRE 1 PULL handle — PULL.
4. FIRE EXT — MAIN.
5. FUEL (both engines) — OFF.
6. FIRE 1 PULL handle — PUSH IN.
7. FIRE 2 PULL handle — PULL.
8. FIRE EXT — RESERVE.
9. MAYDAY — BROADCAST.
10. Autorotative landing — ACCOMPLISH.

Engine Chip Detr Caution Light.

Indications.

1. CHIP DETR caution light (affected engine).
2. MASTER CAUTION light.

Procedure.

In the event of an engine CHIP DETR light with no secondary indications, consideration should be given to applicable single engine procedures without securing the affected engine. The affected engine may be advanced to accomplish a safe landing.

1. Throttle — ENGINE IDLE.
2. LAND AS SOON AS PRACTICAL.

If secondary indications exist:

1. Single engine procedure — EXECUTE.

Engine Oil Pressure Low.

Indications.

1. ENGINE OIL PRESS decreases (affected engine).
2. OIL PRESS caution light (affected engine).
3. MASTER CAUTION light.

Procedure.

1. ENGINE OIL PRESS — CHECK.

If oil pressure is above lower limit:

1. MASTER CAUTION light — RESET.
2. ENGINE OIL P gage — MONITOR.
3. LAND AS SOON AS PRACTICAL.

If oil pressure is below lower limit:

1. Throttle — CLOSE.
2. Single engine procedures — EXECUTE.

Engine Oil Overtemperature.

Indications.

1. ENGINE OIL TEMP high.

Procedure.

1. ENGINE OIL PRESS — CHECK.

If oil temperature is above 116 and oil presssure is below 40 psi:

1. Engine — SHUTDOWN.
2. Single engine procedure — EXECUTE.
3. LAND AS SOON AS POSSIBLE.

Compressor Stalls.

Indications.

1. No throttle response.
2. High or erratic INLET TEMP.
3. Decreasing or erratic GAS PROD (Ng) and ENG RPM (Nf).
4. Rapid engine "chugs" or explosions.

Procedure.

1. Throttle — DECREASE.
2. INLET TEMP — MONITOR.

If compressor stall persists:

1. Throttle — CLOSE.
2. Single engine procedure — EXECUTE.

MAIN DRIVESHAFT FAILURE.

A main driveshaft failure presents the pilot with confusing aural and visual cues that require prompt interpretation and corrective action. ENG RPM (Nf) will indicate overspeeding, but ROTOR RPM (Nr) will decay rapidly and the helicopter will yaw left; the low rotor RPM caution light and audio signal will be activated. Immediate response to the low rotor RPM caution is required to prevent an excessively low rpm situation from which a safe recovery would be extremely difficult.

Indications.

1. High ENG RPM (Nf).
2. Low rotor RPM caution light and audio.
3. Zero TORQUE indication.
4. Grinding sounds.

Procedure.

1. Autorotation — ENTER IMMEDIATELY.
2. Throttles — FLIGHT IDLE.

If time, altitude, and conditions permit:

3. Throttles — CLOSE.
4. FUEL switches — OFF.

ELECTRICAL SYSTEM MALFUNCTIONS.

Failure of One Generator (MASTER ARM Switch Not Required).

Indications.

1. MASTER CAUTION light.
2. DC GEN caution light.
3. AMPS indication of zero.

Procedure.

1. GEN BUS RESET circuit breaker — CLOSED.
2. GEN FIELD circuit breaker — CLOSED.
3. GEN — MOMENTARY RESET, THEN ON.
4. MASTER ARM — OFF.
5. MASTER CAUTION light — RESET.

If the mission does not require the use of the MASTER ARM switch, complete the mission.

Failure of One Generator (MASTER ARM Switch Required).

Indications.

1. MASTER CAUTION light.
2. DC GEN caution light.
3. AMPS indication of zero.

Procedure.

1. GEN BUS RESET circuit breaker — CLOSED.
2. GEN FIELD circuit breaker — CLOSED.
3. GEN — MOMENTARY RESET, THEN ON.
4. MASTER ARM — OFF.

NOTE

The MASTER ARM switch should be kept OFF as much as possible so that the remaining generator can keep the battery charged. With MASTER ARM switch in STBY or ARM, the remaining generator furnishes armament power and the battery furnishes helicopter's power. As battery voltage is depleted, the SCAS performance will be degraded and may disengage.

5. NON-ESS BUS — MANUAL.

NOTE

With the non-essential bus switch in the NORMAL position, the main inverter, the TACAN and the air-conditioner will not be operable. The standby inverter will automatically come on the line and will be powered by the battery.

6. TACAN — AS REQUIRED.
7. ECU/VENT — OFF.
8. Unnecessary equipment — OFF.
9. MASTER CAUTION light — RESET.
10. LAND AS SOON AS PRACTICAL.

Failure of Both Generators.

In the event both generators fail in flight, emergency dc power is supplied by a 24 volt, 34 ampere hour battery. This battery, assuming an 85 percent charge, can supply the essential bus for a period of approximately 32 minutes. With the NON-ESS BUS in MANUAL position, the battery will supply the non-essential bus under emergency conditions for a period of approximately 16 minutes. To conserve battery power, all unneeded navigation equipment and radios should be secured.

Indications.

1. AMPS indicate zero.
2. DC GEN caution light.
3. MASTER CAUTION light.

Procedure.

1. GEN — OFF.
2. NON-ESS BUS — MANUAL.
3. GEN BUS RESET circuit breaker — CLOSED. NEW
4. GEN FIELD circuit breaker — CLOSED.
5. All unnecessary equipment — Off.
6. GEN — RESET, THEN ON.
7. MASTER CAUTION light — RESET.
8. LAND AS SOON AS PRACTICAL.

If generator does not come on:

1. GEN — OFF.
2. LAND AS SOON AS PRACTICAL.

Main Inverter Failure.

Indications.

1. MASTER CAUTION light.
2. AC MAIN caution light.
3. Non essential ac bus functions cease.
4. INV MAIN circuit breaker — OPEN. NEW

NOTE

Loss of dc power from the non-essential bus to the main inverter will result in automatic switch over to the standby inverter. If the main inverter fails internally while dc power is applied, the automatic switch over will not occur.

Procedures.

1. INVERTERS — STBY.
2. INV MAIN circuit breaker — OPEN. NEW
3. MASTER CAUTION light — RESET.
4. SCAS — ENGAGED.
5. LAND AS SOON AS PRACTICAL.

Failure of Both Inverters.

Indications.

1. MASTER CAUTION light.
2. AC STBY caution light.
3. All ac bus functions cease.
4. INV STBY circuit breaker — OPEN. NEW

Procedure.

1. INV STBY circuit breaker — CLOSED. NEW
2. INV MAIN circuit breakers — CLOSED.
3. INVERTERS — MAIN.

If either inverter functions:

1. Unnecessary equipment — OFF.
2. MASTER CAUTION light — RESET.
3. LAND AS SOON AS PRACTICAL.

If neither inverter functions:

1. INVERTERS — OFF.
2. Unnecessary equipment — OFF.
3. MASTER CAUTION light — RESET.
4. LAND AS SOON AS PRACTICAL.

Complete Electrical Failure.

CAUTION

If one or both engines are in manual fuel and power is removed from the 28 vdc essential bus, the fuel control solenoid will de-energize and actuate the automatic fuel control regardless of governor switch position.

Indications.

1. All electrical functions cease.

CAUTION

Total loss of electrical power will cause the loss of all engine and component instruments, indicators, gages and tachometers except for GAS PROD (Ng) tachometers.

NEW

Procedure.

1. Copilot/gunner ELEC PWR — ELEC PWR.
2. Airspeed — REDUCE (100 KIAS or less).
3. LAND AS SOON AS PRACTICAL.

Battery Overtemp/Thermal Runaway

Indications.

1. MASTER CAUTION light.
2. BATTERY TEMP light.
3. High AMPS indication.
4. Smoke or fumes emitting from battery compartment.
5. Muffled bang or thud sound in battery compartment.

Procedure.

1. BATTERY — OFF.

If on deck:

1. Helicopter — SHUTDOWN (alert crash crew).

If in flight:

1. LAND AS SOON AS POSSIBLE.
2. Helicopter — SHUTDOWN (alert crash crew).

WARNING

Do not use fire extinguisher on battery if there is no visible fire because it may cause an explosion. If a visible fire has developed, fire extinguisher may be used.

ELIMINATION OF SMOKE AND FUMES IN COCKPIT.

Indications.

1. Smoke or fumes in cockpit.
2. Equipment failure.

Procedure.

1. ECU/VENT — OFF.

2. Canopy doors — OPEN TO INTERMEDIATE POSITION (at a maximum of 45 KIAS, to eliminate excessive smoke or fumes).

WARNING

Do not discharge hand portable fire extinguishers in closed cockpit due to the possibility of disabling the crew.

ELECTRICAL FIRE.

WARNING

Do not discharge hand portable fire extinguishers in closed cockpit due to the possibility of disabling the crew.

Indications.

1. Smoke or fumes.
2. Equipment failure.
3. Fire.
4. High AMPS indication.

Procedure.

1. Both GEN — OFF.

CAUTION

Do not attempt target run with less than one generator and battery.

NOTE

With both Generators off and the NON-ESS BUS switch in NORMAL, the inverter function automatically switches to the standby inverter.

2. Circuit breakers — CHECK.

CAUTION

Do not reset any circuit breakers that are tripped. It is likely that those circuits are the problem.

3. All unnecessary equipment — OFF.
4. MASTER CAUTION light — RESET.

If fire is not evident and/or an immediate landing is not possible:

5. No. 1 GEN — ON.
6. No. 2 GEN — ON.
7. INVERTERS — MAIN.
8. Necessary equipment — ON.

If fire is evident on any step 5 through 8:

9. Applicable equipment — OFF.
10. Applicable circuit breaker — OPEN. NEW
11. LAND AS SOON AS PRACTICAL.

If evidence of fire persists:

12. Both GEN — OFF.
13. BATTERY — ON (only as required).
14. LAND AS SOON AS POSSIBLE.

CAUTION

SCAS will disengage with no electrical power.

FUSELAGE FIRE IN FLIGHT.

Procedure.

WARNING

Do not discharge hand portable fire extinguishers in closed cockpit due to the possibility of disabling the crew.

1. LAND IMMEDIATELY.

FUEL SYSTEM MALFUNCTIONS.

Fuel Boost Pump Failure.

The helicopter is equipped with two electrically driven fuel boost pumps, either of which is capable of supplying sufficient fuel to both engines. A complete helicopter fuel system failure will not be common because of separate forward and aft fuel boost pumps.

WARNING

Avoid helicopter operation with dual fuel boost pump failure above 6000 ft. pressure altitude. This can result in an engine flame-out due to fuel starvation.

CAUTION

With forward boost pump inoperative, a nose down attitude in excess of 14° will result in 538 pounds or more of unuseable fuel. Flame-out could result.

Indications.

1. FWD or AFT FUEL BOOST caution light.
2. MASTER CAUTION light.
3. A decrease in fuel pressure.
4. FUEL BOOST circuit breaker — OPEN.

Procedure.

1. TANK INTCON — OPEN.
2. CROSS FEED — OPEN.

NOTE

With cross feed closed, fuel pressure gage indicates aft fuel boost pressure only.

3. FUEL BOOST circuit breaker — OPEN.
4. MASTER CAUTION light — RESET.
5. LAND AS SOON AS PRACTICAL.

Engine Driven Fuel Pump Failure.

If the engine driven fuel pump fails, the engine will flame-out due to fuel starvation.

Indications.

1. Engine instruments decrease.
2. Rotor rpm decreases.
3. MASTER CAUTION light.
4. Caution panel lights.

Procedure.

1. Follow procedure for single engine failure in this section.

Engine Fuel Filter Impending Bypass.

Indications

1. FUEL FILTER caution light (affected engine).
2. MASTER CAUTION light.

Procedure.

1. MASTER CAUTION light — RESET.
2. LAND AS SOON AS PRACTICAL.

IMPENDING TRANSMISSION FAILURES.

NEW NEW NEW

An impending transmission failure may be indicated by any unusual noise or vibrations from the transmission area, abnormal transmission oil pressure or temperature indications, transmission oil bypass light, transmission chip light, loss of Nr, or yaw kicks. These indications may occur

singularly or in combination. Generally, there are two extremes that can be expected in a transmission failure; seizure of the drive train or a disconnect of the drive train that would allow the rotor system to turn independently of the engines. If an impending transmission failure is suspected, whether it is due to oil starvation or a power discontinuity, priority must be given to maintaining Nr, descending, and landing as soon as possible. Nr may be maintained by using a combination of collective pitch setting (with throttles full open) and airspeed. A smooth transition to an airspeed providing minimum power requirements should be accomplished. Aircraft controllability will become markedly degraded if Nr decreases below 90 percent.

Indications.

1. Unusual noise or vibrations from transmission areas.
2. XMSN OIL HOT caution light with XMSN OIL TEMP gage high.
3. XMSN OIL PRESS caution light with XMSN OIL PRESS gage low.
4. XMSN OIL BYP caution light with XMSN oil temp gage high.
5. XMSN CHIP DET caution light.
6. MASTER CAUTION LIGHT.
7. Nr low.
8. Yaw kicks.

Procedures.

1. Maintain Nr.
2. Descend — POWER ON.
3. LAND AS SOON AS POSSIBLE.

If Nr decays or more violent vibrations occur:

4. Lower collective with throttles full open.
5. Maintain powered descent.
6. LAND IMMEDIATELY.

If continued flight is mandatory and appears feasible:

1. Establish slow flight of 50 KIAS and 20 feet AGL.

If Nr decays or more violent vibrations occur:

2. Maintain Nr.
3. LAND IMMEDIATELY.

WARNING

- If an engine to transmission disconnect occurs, Nf may tend to overspeed. Priority must be given to maintaining Nr before attempting to control the Nf overspeed.
- Autorotation in the event of transmission oil starvation may contribute to transmission seizure.
- In certain modes of transmission failures, loss of hydraulic systems or tail rotor drive may occur.

CAUTION

- With indications of an impending transmission failure, an approach should be made with minimum power changes to minimize the chance of seizure. Control movements should also be kept to a minimum.
- Because of the "wet bulb" temperature system, oil starvation may not be accompanied by a rising temperature.

COMBINING GEARBOX MALFUNCTIONS.

WARNING

Power shall be maintained throughout approach and landing to aid in preventing seizure of gears.

Combining Gearbox Oil Overtemperature.

Indications.

1. C BOX OIL HOT caution light.
2. MASTER CAUTION light.
3. GEARBOX OIL TEMP high.

Procedures.

NEW
1. Collective — DECREASE.
2. GEARBOX OIL TEMP — CHECK.
3. GEARBOX OIL PRESS — CHECK.
4. MASTER CAUTION light — RESET.
5. LAND AS SOON AS PRACTICAL.

If GEARBOX OIL TEMP indication is above limit, or if GEARBOX OIL PRESS is below limit:

1. LAND AS SOON AS POSSIBLE.

Combining Gearbox Oil Pressure Low.

Indications.

1. C BOX OIL PRESS caution light.
2. MASTER CAUTION light.
3. GEARBOX OIL PRESS indicates low.

Procedure.

NEW
1. Collective — DECREASE.
2. GEARBOX OIL PRESS — CHECK.
3. GEARBOX OIL TEMP — CHECK.
4. MASTER CAUTION light — RESET.
5. LAND AS SOON AS PRACTICAL.

If GEARBOX OIL PRESS indicator is below limits, or if combining GEARBOX OIL TEMP is above limits:

1. LAND AS SOON AS POSSIBLE.

Combining Gearbox Chip Detector.

Indications.

1. C BOX CHIP DETR caution light.
2. MASTER CAUTION light.
3. Grinding noise.

Procedure.

1. LAND AS SOON AS POSSIBLE.

If accompanied by C BOX OIL HOT caution light and/or C BOX OIL PRESS caution light:

1. LAND IMMEDIATELY.

42 DEGREE AND 90 DEGREE GEARBOX MALFUNCTIONS.

42 Degree/90 Degree Gearbox Oil Overtemperature, or Low Pressure.

Indications.

1. 42°/90° TEMP/PRESS caution light.
2. MASTER CAUTION light.

Procedure.

NEW
1. Collective — DECREASE.
2. MASTER CAUTION light — RESET.
3. LAND AS SOON AS POSSIBLE.

42°/90° Chip Detector

Indications.

1. 42°/90° CHIP DETR caution light.
2. MASTER CAUTION light.

Procedure.

NEW
1. Collective — DECREASE.
2. MASTER CAUTION light — RESET.
3. LAND AS SOON AS PRACTICAL.

If accompanied by 42°/90° TEMP/PRESS caution light:

1. LAND AS SOON AS POSSIBLE.

ROTOR BRAKE PRESSURIZED IN FLIGHT.

Indications.

1. ROTOR BRAKE warning light.
2. Rotor brake handle out of down position.
3. Decrease in rotor rpm.
4. RPM caution light and audio.

Procedure.

1. Rotor brake handle — FULL DOWN.

If warning light remains on:

2. HYD switch — SYS 2 OFF.
3. ROTOR RPM — MONITOR.

CAUTION

With hydraulic system 2 OFF, SCAS pitch and roll channels will be inoperative.

4. LAND AS SOON AS PRACTICAL.

If warning light remains on:

1. LAND AS SOON AS POSSIBLE.

WING STORES JETTISON.

Each of the four ejector racks are equipped with an electrically operated ballistic device to jettison the attached weapon. The pilot can select one or all stations for jettison. The copilot/gunner can select inboard, outboard or both.

NOTE

Jettisoning inboard stores with 4 TOW launchers installed will cause the outboard store to be jettisoned first regardless of outboard jettison switch positions.

Pilot Procedures For Jettisoning.

1. EMERGENCY JETTISON SELECT — ON (as appropriate).
2. JETTISON button — DEPRESS (at least one second).
3. EMERGENCY JETTISON SELECT — AS APPROPRIATE.

Copilot/Gunner Procedures for Jettisoning.

1. WING STORES JETTISON INBD, OUTBD, or BOTH (as appropriate).
2. JETTISON cover — UP.
3. WGST JTSN — UP.
4. JETTISON cover — DOWN.
5. WING STORES JETTISON — BOTH.

LOST PLANE PROCEDURES.

The primary requirements when lost are as follows:

1. Confess.
2. Climb.
3. Conserve.
4. Communicate.
5. Conform.

LOST SIGHT DURING IMC

NEW NEW

In the event of lost sight during IMC flight, the reversal base course will be the reciprocal of the flight present heading. Upon signal, the helicopters will acknowledge and take the following action. See figure 5-2.

1. Helicopter numbers two and four will commence a standard rate turn away from the flight. They will call passing through 90 degrees of turn and will turn 170 degrees.
2. Helicopter number three will climb 500 feet on the present heading, after completing the climb the helicopter will reverse heading away from the flight leader, 170 degrees. When number four helicopter reports passing

through 90 degrees upon completing the reversal turn, helicopter number three will descend to the initial altitude.

3. The flight leader, upon receiving the radio call of helicopter number two passing through 90 degrees of turn, will reverse course 180 degrees on the same side as helicopter number two.

4. It is essential that all helicopters maintain the airspeed of the flight when the dispersal was commenced. The flight will regroup when in a clear area.

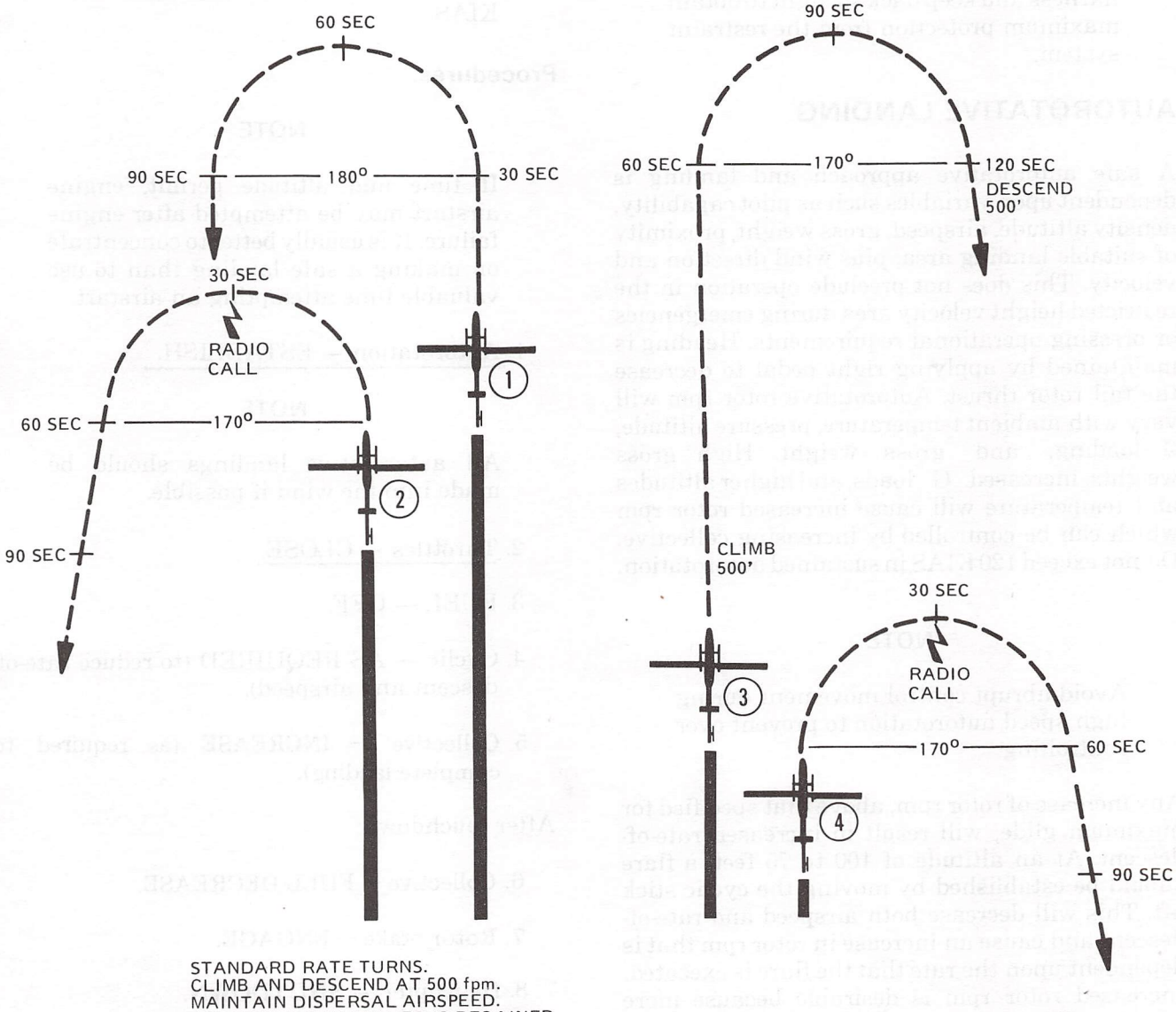


Figure 5-2. Lost Sight During IMC Flight Procedures

NEW

PART 4 — LANDING EMERGENCIES

WARNING

When anticipating an emergency landing or ditching, each crewman should place his shoulders against the seat back, manually lock the shoulder harness and keep back straight to obtain maximum protection from the restraint system.

AUTOROTATIVE LANDING.

A safe autorotative approach and landing is dependent upon variables such as pilot capability, density altitude, airspeed, gross weight, proximity of suitable landing area, plus wind direction and velocity. This does not preclude operation in the restricted height velocity area during emergencies or pressing operational requirements. Heading is maintained by applying right pedal to decrease the tail rotor thrust. Autorotative rotor rpm will vary with ambient temperature, pressure altitude, G loading, and gross weight. High gross weights, increased G loads, and higher altitudes and temperature will cause increased rotor rpm which can be controlled by increasing collective. Do not exceed 120 KIAS in sustained autorotation.

NOTE

Avoid abrupt control movement during high speed autorotation to prevent over controlling.

Any increase of rotor rpm, above that specified for maximum glide, will result in increased rate-of-descent. At an altitude of 100 to 75 feet, a flare should be established by moving the cyclic stick aft. This will decrease both airspeed and rate-of-descent and cause an increase in rotor rpm that is dependent upon the rate that the flare is executed. Increased rotor rpm is desirable because more energy will then be available to the main rotor when collective is applied. Sites for autorotative landings should be hard, flat, smooth surfaces clear of approach and rollout obstructions. During landing the helicopter should be held in a skids level attitude and, when contact is made with the ground, the cyclic stick should be moved slightly forward of the neutral position. After touchdown, decrease collective slowly to full down.

NOTE

The best glide airspeed is 110 KIAS. The minimum rate of descent airspeed is 65 KIAS.

Procedures.

NOTE

If time and altitude permit, engine airstart may be attempted after engine failure. It is usually better to concentrate on making a safe landing than to use valuable time attempting an airstart.

1. Autorotation — ESTABLISH.

NOTE

All autorotative landings should be made into the wind if possible.

2. Throttles — CLOSE.
3. FUEL — OFF.
4. Cyclic — AS REQUIRED (to reduce rate-of-descent and airspeed).
5. Collective — INCREASE (as required to complete landing).

After touchdown:

6. Collective — FULL DECREASE.
7. Rotor brake — ENGAGE.
8. Helicopter — SHUTDOWN.

SINGLE ENGINE LANDING

Procedure.

Under certain conditions, airspeed in excess of 25 KIAS may be necessary to land single engine. NEW

LANDING IN TREES.

An autorotation into a heavily wooded area should be accomplished by executing a normal autorotative approach and full flare. The flare should be executed so as to reach zero rate of descent and zero ground speed as close to the top of the trees as possible. As the helicopter settles, increase collective to maximum.

DITCHING.

When the decision is made to ditch:

WARNING

- Do not abandon helicopter until rotor blades have stopped.
- Do not inflate life vest until well clear of the helicopter.

Procedure.

1. Transponder MASTER — EMER.
2. MAYDAY — BROADCAST (give position).

Ditching — Power On.

Procedure.

Perform normal approach to hover 3 to 5 feet above the water.

1. Canopy jettison handle — ROTATE (counterclockwise 90 degrees) PULL.
2. Both throttles — CLOSE.
3. Collective — INCREASE (smoothly to cushion landing).

As helicopter settles:

4. Collective — INCREASE (to maximum).
5. Rotor brake — ENGAGE.

When rotor blades have stopped:

6. Helicopter — EXIT.

When well clear of the helicopter.

7. Life vest — INFLATE.

Ditching — Power Off.

Procedure.

1. Autorotation — ESTABLISH.
2. Canopy jettison handle — ROTATE (counterclockwise 90 degrees) PULL.

WARNING

Helmet visors shall be down prior to activation of the CRS to preclude eye injury.

3. Collective — INCREASE (smoothly to cushion landing).

As helicopter settles:

4. Collective — INCREASE (to maximum).
5. Rotor brake — ENGAGE.

When rotor blades have stopped:

6. Helicopter — EXIT.

When well clear of helicopter:

7. Life vest — INFLATE.

NEW NEW NEW

SECTION VI — ALL WEATHER OPERATION

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INTRODUCTION.

The purpose of this section is to provide information and procedures for operating under light icing, cold weather and instrument flight conditions. This section does not include equipment descriptions since this information is contained in Section I. Detailed instrument procedures are discussed in the NATOPS INSTRUMENT FLIGHT MANUAL.

NOTE

- Because of various controllable modes of helicopter flight, the possibility of pilot vertigo caused by sideward motion or oscillation is a more prevalent hazard during night and instrument flight than it is in fixed-wing flight.

- Under instrument conditions particularly at night, through conditions of reduced visibility, unnecessary operation of the anti-collision light should be avoided. Uncommon reflection on the helicopter's windows caused by rotating light being reflected back from the clouds through the whirling blades may cause vertigo. Crew coordination is discussed in Section IX.

PART 1 — INSTRUMENT PROCEDURES

INSTRUMENT FLIGHT PROCEDURES.

Simulated Instrument Flight.

Safety precautions and detailed procedures for conducting simulated instrument flights are contained in OPNAVINST 3710.24 series.

Start.

Complete normal exterior inspections and the prestart/start checklist items.

Instrument Flight Checklist.

1. Maps, supplement, approach plates — As required.
2. Fuel packet — If required.
3. Cockpit heating equipment — Check operation.
4. PITOT heater — Check operation.
5. RAIN RMV — Check operation.

CAUTION

Extended use of the RAIN RMV system can cause damage.

6. Magnetic compass — Check.
7. Vertical velocity indicator — Check needle position.
8. Altimeters — Check and set.
9. Clock — Set.
10. Radios and IFF — Check and set.
11. AN/ASN-75 compass — Slaved, check alignment.

Air Taxi.

1. AN/ASN-75 compass — Check operation.
2. Turn and slip indicator — Check alignment and operation.
3. Attitude indicator — Check alignment, operation, and set horizontal bar.
4. Magnetic compass — Check operation.
5. Vertical velocity indicator — Check operation.
6. Exterior lights — As desired.

Instrument Takeoff.

When a normal hover is not possible, the helicopter may be flown off the deck and into a normal climb without any outside reference.

1. Maintain a level attitude with reference to the attitude indicator.
2. As the helicopter becomes airborne, move the cyclic control stick forward and adjust collective pitch as necessary for transition into a forward speed climbing flight.

NOTE

The airspeed indicator is unreliable at airspeeds less than 40 knots.

3. Establish a rate-of-climb of at least 500 feet per-minute with reference to the altimeter and vertical speed indicator.

NOTE

Normally, turns should not be executed prior to reaching 200 feet altitude.

4. Maintain a smooth acceleration up to 100 knots with reference to the attitude indicator and the airspeed indicator.

Instrument Climb.

Climb under instrument conditions is similar to the climb technique and procedure described in Section III. Under instrument conditions use the best rate of climb speed for the operating gross weight. Climbing turns should be limited to a maximum bank of 20 degrees.

Instrument Cruising Flight.

After leveling off, stabilize airspeed and power. Particular attention should be given to navigation since the slow airspeed associated with helicopters can result in large drift angles.

SPEED RANGE.

A minimum speed of 70 knots should be observed to maintain the normal flight characteristics associated with forward flight.

ELECTRONIC EQUIPMENT.

Radio and navigation equipment are operated in the normal manner.

HOLDING.

An airspeed of approximately 100 knots can be easily maintained in the normal holding pattern. However, a navigational problem will be present while attempting to maintain a pattern in high wind.

NOTE

Drift correction angles of 30 degrees are not uncommon to a helicopter.

Descent.

Normal descents are made by reducing power until the desired rate-of-descent is accomplished. Enroute descents are normally made at cruising airspeed.

PART 2 — EXTREME WEATHER OPERATION

COLD WEATHER OPERATION.

Introduction.

Operation of the helicopter in cold weather or an arctic environment presents no unusual problems if the pilot is aware of the changes that take place and conditions that may exist because of the lower temperatures and freezing moisture. The pilot must be more thorough in the walk-around inspection when temperatures have been or are below zero degrees C (plus 32 degrees F).

Engine Servicing.

Fuel and oil servicing should be accomplished immediately after engine shutdown to prevent condensation within the tanks due to temperature change. Refer to the Servicing Diagram figure 1-32.

Engine Ground Operation.

During extreme conditions, install covers after engine shutdown. In extreme cold weather ground heater unit may be used.

Snow, slush, or ice shall be removed from any area where jet engines may be operated. Keeping the areas clean will prevent cinders, sand, or chunks of ice from being sucked into the engines or blown at high velocity into other aircraft that might be in the vicinity.

During extreme cold weather, external vents and drains shall be inspected prior to operating engines and prior to flight.

CAUTION

Should the engines fail to accelerate to proper idle speed (cold hang-up) or the time from light-off to idle is excessive, abort start. Refer to utilization of Manual Fuel for Cold Start Section VI.

An auxiliary power unit should be used, when available, to ensure a smooth, fast engine acceleration.

A sudden loss of oil pressure in cold weather, other than a drop caused by relief valve opening, is usually due to a broken oil line. Shutdown and investigate for cause.

Install engine inlet and exhaust covers after shutdown.

Utililization Of Manual Fuel For Cold Start.

Certain characteristics of the fuel control during cold weather operation, although not affecting the engine light off capabilities, will cause the gas producer turbine to hang up and not accelerate to idle speed, with Ng and ITT remaining low. In this case, the GOV switch may be placed in MANUAL after light off to bypass the automatic features of the control and provide manual scheduling of fuel as selected by the pilot.

Rapid throttle movement with possible ice accumulation in the compressor could result in stall when GOV switch is positioned to MANUAL. Refer to Underspeeding Nf Governor, Section V. After start has been completed, the GOV switch should be switched to AUTO.

CAUTION

Do not operate the engine in excess of 71 percent Ng until engine and combining gearbox oil temperatures reach +15 degrees C.

Preparation for Flight.

Preparation for cold weather flights should include normal procedures in Section IV with the following exceptions or additions: All vents and openings such as fuel vents, battery vents, transmission breather, heater exhaust and intake, and engine air intakes must be checked for ice.

WARNING

Accumulation of snow and ice will be removed prior to flight. Failure to do so can result in hazardous flight, due to aerodynamic and center of gravity disturbances as well as the introduction of snow, water and ice into internal moving parts and electrical systems. The pilot should be particularly attentive to the main and tail rotor systems and their exposed control linkages.

NOTE

At temperatures of minus 35 degrees C (minus 31 degrees F) and lower, the grease in the couplings of the main transmission driveshaft may congeal to a point that the couplings cannot operate properly. If found frozen, apply heat to thaw the couplings, before attempting to start the engines. Indication of proper operation is obtained by turning the main rotor blade opposite to the direction of the rotation while an observer watches the driveshaft to see that there is no tendency for the transmission to "wobble" while the driveshaft is turning.

PREHEATING.

Whenever outside ambient temperatures are minus 40 degrees, preheating of the engines, gearbox, transmission, and associated system components is required. Flight and engine controls may be difficult to move after the helicopter has been cold soaked. If the controls are not sufficiently free for a safe start and low power warm-up, have the affected controls thawed by heating. It may also be advisable to apply pre-heating to other areas such as the engines, transmission, main rotor hub, and cockpit.

NOTE

When moving the helicopter into or out of a heated hangar where there is an extreme

difference in outside temperature, a canopy door should be open slightly to equalize the temperature inside the cockpit. Extremely unequal temperatures on opposite sides of plexiglas can cause differential contraction and breakage.

Main Rotor Blades and Elevator.

Visually check upper surfaces to be free of ice and snow. Untie the blades and walk through 360 degrees in the direction of rotation and check to see that there is no restriction in operation or flapping freedom due to ice formation. Check synchronized elevator for ice and snow on surface and for restricted movement due to ice and snow between fuselage and elevator.

Before Starting Engines.

An auxiliary power unit should be used when available to ensure a smooth, fast engine acceleration to preclude a hot start.

CAUTION

Whenever possible, avoid starting engines on glare ice to avoid the effect of torque reaction when increasing rpm.

NOTE

Battery starts below minus 15 degrees C are marginal.

Starting Engines.

When outside air temperature is between minus 18 degrees C and minus 32 degrees C (zero degrees F and minus 25 degrees F), accomplish the following procedures in addition to those listed in Section II.

Do not advance beyond 71 percent Ng until both engines, combining gearbox, and transmission oil pressures are stabilized within desired operating range.

WARNING

Under cold weather conditions, make sure all instruments have warmed up sufficiently to ensure normal operation. Check for sluggish instruments before takeoff.

CAUTION

A sudden loss of oil pressure in cold weather, other than a drop caused by relief valve opening, is usually due to a broken oil line. Shutdown and investigate for cause.

NOTE

Before takeoff under icy conditions, check that landing gear is not frozen to the ground.

ICING.

Icing in the air intake system will be evidenced in the cockpit only as a power loss (which could be as much as 5 percent) and a corresponding increase in Ng, RPM of less than 2 percent.

Air Taxi (Snow Conditions).

NEW NEW NEW NEW NEW

Operating the helicopter during conditions of snow may result in a hazardous situation known as "whiteout". Whiteout, or circulation of snow through the rotorwash, can occur during air taxi, when in a hover, or on short final to landing. It is potentially hazardous because the pilot may lose visual reference outside the cockpit. Air taxiing should be at an airspeed that will keep the snow cloud aft of the stub wings (approximately 10-15 knots depending on the wing). Care should be taken not to air taxi near another operating aircraft.

Takeoff.

NOTE

NEW NEW

It may be necessary to get the aircraft light on the skids and apply small pedal pressure to ensure the skids are not frozen to the ground.

Cold weather presents no particular takeoff problem unless the cold weather is accompanied by snow. The problem of restricted visibility due to blowing or swirling snow (from rotor wash) can be acute and may require a maximum power takeoff, or perhaps even an instrument takeoff without hover to get the helicopter safely airborne. Use available objects for reference, such as smoke grenades, oil drums, rocks, etc. If the takeoff is surrounded by a large expanse of smooth, unbroken snow there is danger that the pilot may become disoriented because of the absence of visible ground reference objects.

Icing Conditions.

Flight through icing conditions should be avoided. However, should icing be inadvertently encountered, the aircraft may exhibit the following characteristics:

ENGINES.

The engines will continue to perform with no noticeable power degradation for up to 60 minutes in light icing (½ inch per 40 miles) at temperatures down to −20 degrees C.

RAIN REMOVAL AND PITOT HEAT.

Both of these systems will continue to perform satisfactorily in icing conditions. Both systems should be activated when flying through visible moisture at temperatures of 0 degrees C and below.

ROTOR SYSTEM.

Ice will build on the rotor blades and shed naturally in 15-20 minute cycles after encountering icing conditions. Ice build-ups on the rotor system are characterized by a concurrent increase in torque and ITT. Initiation of the shed cycle usually results in a one-per-rev vibration due to asymmetrical shedding. Vibrations are of light to heavy intensity. If vibrations are encountered immediately after or during flight through icing conditions, rapidly beeping the rotor system through its entire range may alleviate the problem. Regardless, the shed cycle should be complete in 5 to 10 minutes after vibrations are initially encountered. After the shed cycle is complete, torque and ITT should drop.

AIRFRAME.

Ice build-up can be monitored by observing the stub wing and the forward section of either skid.

IN-FLIGHT.

Prior to or immediately after encountering icing conditions, use RAIN RMV to keep windshield clear prior to ice formation.

CAUTION

RAIN RMV system should be turned OFF as soon as cleared vision will permit. Heat may melt windshield if operated for a lengthy period on a dry windshield.

Landing.

In normal operations helicopters are often required to land or maneuver in areas other than prepared airfields. In cold weather this frequently involves landing and taking off from snow covered terrain. The snow depth is usually less in open areas where there is little or no drift effect. The snow depth is usually greater on the downwind side of ridges and wooded areas. Whenever possible, the pilot should familiarize himself with the type of terrain under the snow (tundra, brush, marshland, etc.).

On all snow landings anticipate the worst conditions; that is, restricted visibility due to loose whirling snow and an unfirm ice crust under the snow. When loose or powdery snow is expected, make an approach and landing with little or no hover to minimize the effect of rotor wash on the snow. If possible, have some prominent ground reference objects in view during the approach and landing. If no such objects are available, a smoke grenade, etc. dropped from the helicopter may suffice.

In flights of two or more, separation should be extended prior to arriving in the landing zone to preclude the possibility of having to land in a snow cloud produced by another aircraft.

NEW NEW

WARNING

If visual reference is lost, accomplish a go-around.

CAUTION

- Whenever possible, when landing on glare ice, reduce sink rate as much as practical, in order to reduce bending loads on the crosstubes.
- Radio and radar waves can penetrate the surface of snow and ice fields, (such as the polar region) therefore when radio and radar equipment are used for measuring terrain clearance, they may indicate greater terrain clearance than actually exists.

After contacting the surface, maintain rotor rpm and slowly decrease collective pitch, while slightly rotating the cyclic stick until the helicopter is firmly on the ground. Be ready to takeoff immediately if, while decreasing collective pitch, one landing gear should hang up or break through the crust. Do not reduce rotor rpm until it is positively determined that the helicopter will not settle.

Shutdown.

The rotor brake should not be used on shutdown to preclude airframe damage due to inducing main rotor blade ice shedding. Should operational requirements dictate use of the rotor brake, the rotor system should be allowed to coast down to 30 percent RPM before gently applying the rotor brake.

Post-flight.

Inspect underside of both main rotor blades after shutdown for possible damage due to tail rotor blade ice shedding.

Before Leaving The Helicopter.

Perform the following checks in addition to those listed in Section II: Open pilot and copilot/gunner canopy doors approximately one and one-half inches to permit free circulation of air to retard frost formation and reduce cracking of transparent surfaces due to differential contraction. Check that moisture accumulations are drained as soon as possible after engine shutdown. Check fuel cell sumps, fuel strainer, transmission oil sump, and engine oil systems. Check all vents for ice stoppage.

HOT WEATHER OPERATION.

Operations when outside air temperatures are above standard day conditions do not require any special handling technique or procedures, other than a closer monitoring of oil temperatures and ITT. As ambient temperature increases, engine efficiency decreases; and power can become critical under high gross weight conditions on extremely hot days.

Desert Operation.

Desert operation generally means operation in a very hot, dusty, and often windy atmosphere. Under such conditions sand and dust will often be found in vital areas of the helicopter. Severe damage to the affected parts may be caused by sand and dust. The helicopter should be towed into takeoff position, which if at all possible, should be on a hard, clear surface, free from sand and dust. Ensure the engine inlets are free of sand, heavy dust accumulation, and other foreign matter. Use normal starting procedures.

NOTE

During warm weather, oil temperature will probably be on the high side of the operating range.

Install engine inlet and exhaust covers after shutdown.

Preparation For Flight.

Plan the flight thoroughly to compensate for existing conditions by using the charts in Section XI. Check for the presence of sand and dust in control hinges and actuating linkages. Inspect for, and have removed, any sand or dust deposits on instrument panel and switches, and on and around flight and engine controls.

MOUNTAIN AND ROUGH TERRAIN FLYING.

Many helicopter missions require flight and landings in rough and mountainous terrain. Refined flying techniques, along with complete and precise knowledge of the individual problems to be encountered, are required. Landing site condition, wind direction and velocity, gross weight limitations, and effects of obstacles are a few of the considerations for each landing or takeoff. In a great many cases, meteorology facilities and information are not available at the site of intended operation. The effects of mountains and vegetation can greatly vary wind conditions and temperatures. For this reason, each landing site must be evaluated at the time of intended operation. Altitude and temperature are major factors in determining helicopter power performance. Gross weight limitations under specific conditions can be computed from the performance data in Section XI. A major factor improving helicopter lifting performance is wind. Weight carrying capability increases rapidly with increases in wind velocity relative to rotor system. However, accurate wind information is more difficult to obtain and more variable than other planning data. It is therefore not advisable to include wind in advanced planning data, except to note that any wind encountered in the operating area may serve to improve helicopter performance. In a few cases, operational necessity will require landing on a prepared surface at an altitude above the hovering capability of the helicopter. In these cases, a sliding landing and takeoff will be necessary to accomplish the mission. Data for these conditions can be computed from the charts in Section XI.

Wind Direction and Velocity.

There are several methods of determining the wind direction and velocity in rough areas. The most reliable method is by the use of smoke generators. However, it must be noted that the hand held day/night distress signal and the standard ordnance issue smoke hand grenade, although satisfactory for wind indication, constitute a fire hazard when used in areas covered with combustible vegetation. Observation of foliage will indicate to some degree

the direction of the wind, but is of limited value in estimating wind velocity. Helicopter drift determined by eyesight without the use of navigational aids is the first method generally used by experienced pilots. The accuracy with which wind direction may be determined through the "drift" method becomes a function of wind velocity. The greater the wind value the more closely the direction may be defined.

Landing Site Evaluation.

Five major considerations in evaluating the landing area are: (1) height of obstacles which determine approach angle; (2) size and topography of the landing zone; (3) possible loss of wind effect; (4) power available; and (5) departure route. The transition period is the most difficult part of any approach. The transition period becomes more critical with increased density altitude and/or gross weight, therefore approaches must be shallower and transition more gradual. As the height of the obstacles increase, larger landing areas will be required. As wind velocity increases so does helicopter performance; however, when the helicopter drops below an obstacle a loss of wind generally occurs as a result of the airflow being unable to immediately negotiate the change prevalent at the upwind side of the landing zone where a virtual null area exists. This null area extends toward the downwind side of the clearing and will become larger as the height of the obstacle and wind velocity increases. It is therefore increasingly important in the landing phase that this null area be avoided if marginal performance capabilities are anticipated. The null area is of particular concern in making a takeoff from a confined area. Under heavy load or limited power conditions it is desirable to have sufficient airspeed and translational lift prior to transitioning to a climb, so that the overall climb performance of the helicopter will be improved. If the takeoff cycle is not commenced from the most down wind portion of the area and translational velocity achieved prior to arrival in the null area, a significant loss in lift may occur at the most critical portion of the takeoff. It must also be noted that in the vicinity of the null area nearly vertical downdraft of air may be encountered, which will further reduce the actual climb rate of the helicopter. It is feasible that under certain combinations of limited area, high obstacles upwind, and limited power available, the best takeoff route would be either crosswind or downwind, terrain permitting. The effects of detrimental wind flow and the requirement to climb may thus be minimized or circumvented. Even though this is a departure from the cardinal rule of "takeoff into the wind" it may well be the proper solution when all factors are weighed in their true perspective. Never plan an approach to a confined area wherin there is no reasonable route of departure. The terrain within a site is considered from an evaluation of vegetation, surface characteristics, and slope. Care must be taken to avoid placing the rotor in low brush or branches. Obstacles covered by grass may be located by flattening the grass with rotor wash prior to landing. Power should be maintained so that an immediate takeoff may be accomplished should the helicopter start tipping from soft earth or a skid being placed in a hidden hole.

Effects of High Altitude.

Engine power available at altitude is less, and hovering ability can be limited. High gross weight at altitude increases the susceptibility of the helicopter to blade stall. Conditions that contribute to blade stall are high forward speed, high gross weight, high altitude, induced "G" loading and turbulence. Shallower turns at slower airspeeds are required to avoid blade stall. A permissible maneuver at sea level must be tempered at a higher altitude. Smooth and timely control application and anticipation of power requirements will do more than anything else to improve altitude performance.

Turbulent Air Flight Techniques.

Helicopter pilots must be constantly alert to evaluate and avoid areas of severe turbulence; however, if encountered, immediate steps must be taken to avoid continued flight through it to preclude the structural limits of the helicopter being exceeded. Severe turbulence is often found in thunderstorms, and helicopter operations should not be conducted in their vicinity. The most frequently encountered type of turbulence is orographic turbulence. It can be dangerous if severe and is normally associated with updrafts and downdrafts. It is created by moving air being lifted by natural or man made obstructions. It is most prevalent in mountainous regions and is always present in mountains if there is a surface wind. Orographic turbulence is directly proportional to the wind velocity. It is found on the upwind of slopes and ridges near the tops and extending down the downwind slope (figure 6-1). It will always be found on the tops of ridges associated with updraft in the upwind side and downdrafts on the downwind

side. Its extent on the downwind slope depends on the strength of the wind and the steepness of the slope. If the wind is fairly strong (15 to 20 knots) and the slope is steep, the wind will have a tendency to blow off the slope and not follow it down; however, there will still be some tendency to follow the slope. In this situation there will probably be severe turbulence several hundred yards downwind of the ridge at a level just below the top. Under certain atmospheric conditions, a cloud may be observed at this point. On more gentle slopes the turbulence will follow down the slope, but will be more severe near the top. Orographic turbulence will be affected by other factors. The intensity will not be as great when climbing a smooth surface as when climbing a rough surface. It will not follow sharp contours as readily as gentle contours. Man-made obstructions and vegetation will also cause turbulence. Extreme care should be taken when hovering near buildings, hangers, and similar obstructions. The best method of overfly ridge lines from any direction is to acquire sufficient altitude prior to crossing to avoid leeside downdrafts. If landing on ridge lines (figure 6-2), the approach should be made along the ridge in the updraft, or select an approach angle into the wind that is above the leeside turbulence. When the wind blows across a narrow canyon or gorge (figure 6-3) it will often veer down into the canyon. Turbulence will be found near the middle and downwind side of the canyon or gorge. When a helicopter is being operated at or near its service ceiling and a downdraft of more than 1.6 feet per second is encountered the helicopter will descend. Although the downdraft does not continue to the ground, a rate-of-descent may be established of such magnitude that the helicopter will continue descending and crash even though the helicopter is no longer affected by the downdraft. Therefore, the procedure for transiting a mountain pass shall be to fly close abeam that side of the pass or canyon which affords an upslope wind. This procedure not only provides additional lift but also provides a readily available means of exit in case of emergency. Maximum turning space is available and a turn into the wind is also a turn to lower terrain. The often used procedure of flying through the middle of a pass to avoid mountains invites disaster. This is frequently the area of greatest turbulence (figure 6-4) and in case of emergency, the pilot has little or no opportunity to turn back due to insufficient turning space. Rising air currents created by surface heating causes convective turbulence. This is most prevalent over bare areas. Convective turbulence is normally found at a relative low height above the terrain, generally below 2000 feet. It may, however, reach as high as 8000 feet above the terrain. Attempting to fly over convective turbulence should be carefully considered, depending on the mission assigned. The best method is to fly at the lowest altitude consistent with safety. Attempt to keep your flight path over areas covered with vegetation. Turbulence can be anticipated when transitioning from bare areas to areas covered by vegetation or snow. Convective turbulence seldom gets severe enough to cause structural damage.



Figure 6-1. Wind Flow Over and Around Peaks

Adverse Weather Conditions.

When flying and around mountainous terrain under adverse weather conditions, it should be remembered that the possibility of inadvertent entry into clouds is ever present.

Air currents are unpredictable and may cause cloud formations to shift rapidly. Since depth perception is poor with relation to distance from cloud formation and to cloud movement, low hanging clouds and scud should be given a wide berth at all times. In addition to being well briefed, the pilot should carefully study the route to be flown. A careful check of the helicopter compass should be maintained in order to fly a true heading if the occasion demands.

Summary.

The following guide lines are considered to be most important for mountain and rough terrain flying:

1. Make a continuous check of wind direction and estimated velocity.

2. Plan your approach so that an abort can be made downhill and/or into the wind without climbing.

3. If the wind is relatively calm try to select a hill or knoll for landing so as to take full advantage of any possible wind affect.

4. When evaluating a landing site in non-combat operations, execute as many fly-bys as necessary with at least one high and one low pass before conducting operations into a strange landing area.

5. Evaluate the obstacles in the landing site and consider possible null areas and routes of departure (figure 6-5).

6. Landing site selection should not be based solely on convenience but consideration should be given to all relevant factors.

7. Determine ability to hover out of ground effect prior to attempting a landing.

8. Watch for rpm surges during turbulent conditions. Strong updrafts will cause rpm to increase, whereas downdraft will cause rpm to decrease.

9. Avoid flight in or near thunderstorms.

10. Give all cloud formations a wide berth.

11. Fly as smoothly as possible and avoid steep turns.

12. Cross mountain peaks and ridges high enough to stay out of downdrafts on the leeside of the crest.

13. Avoid downdrafts prevalent on leeward slopes.

14. Plan your flight to take advantage of the updrafts on the windward slopes.

15. Whenever possible, approaches to ridges should be along the ridge rather than perpendicular.

16. Avoid high rates of descent when approaching landing sites.

17. Know your route and brief well for flying in these areas.

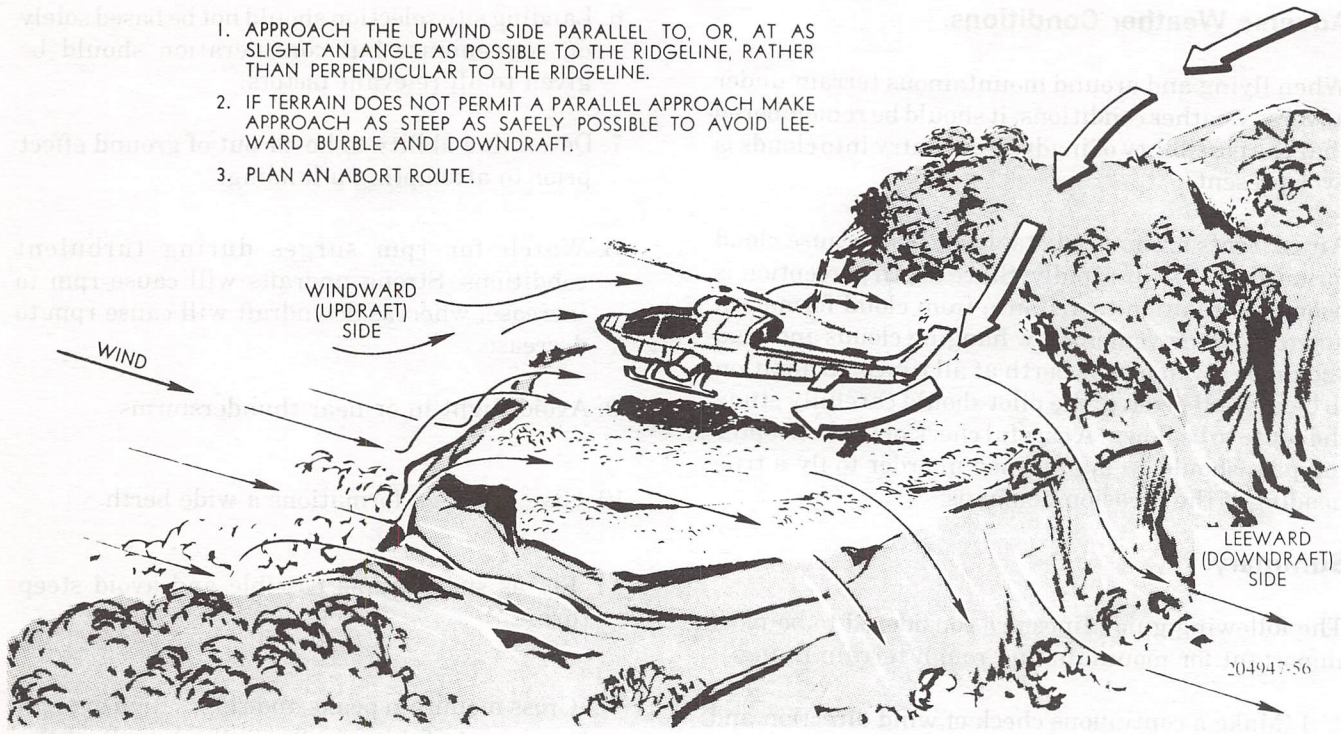


Figure 6-2. Crosswind Effect On Pinnacle Approach

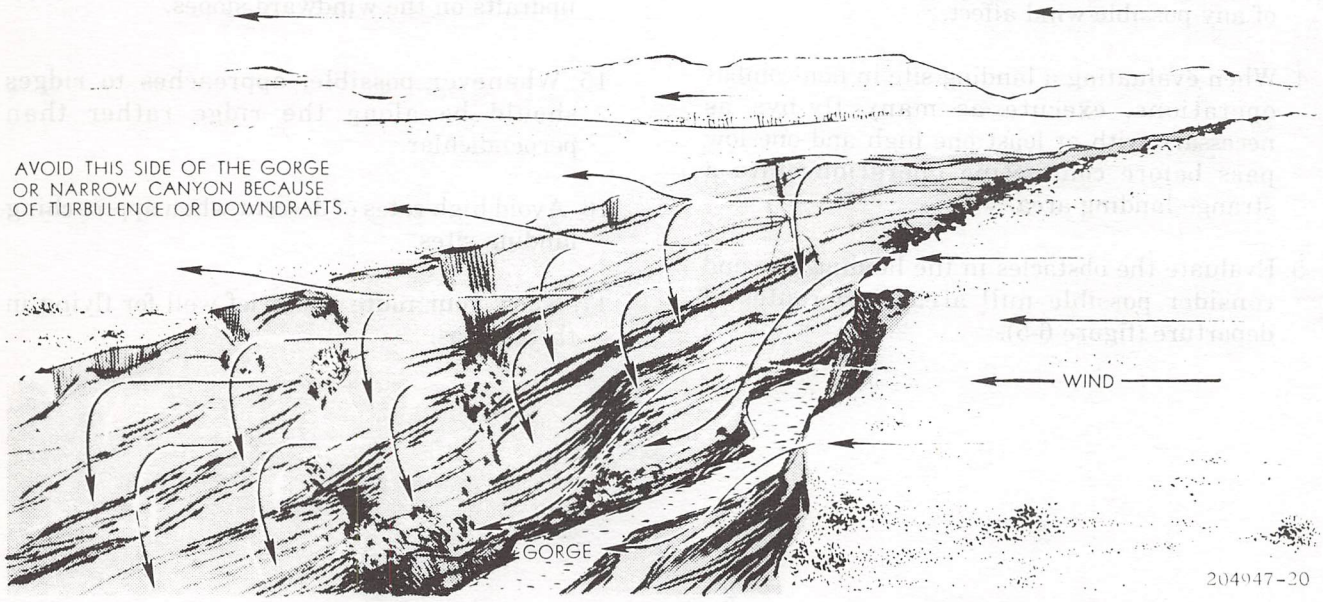


Figure 6-3. Wind Effect Over Gorge Or Canyon

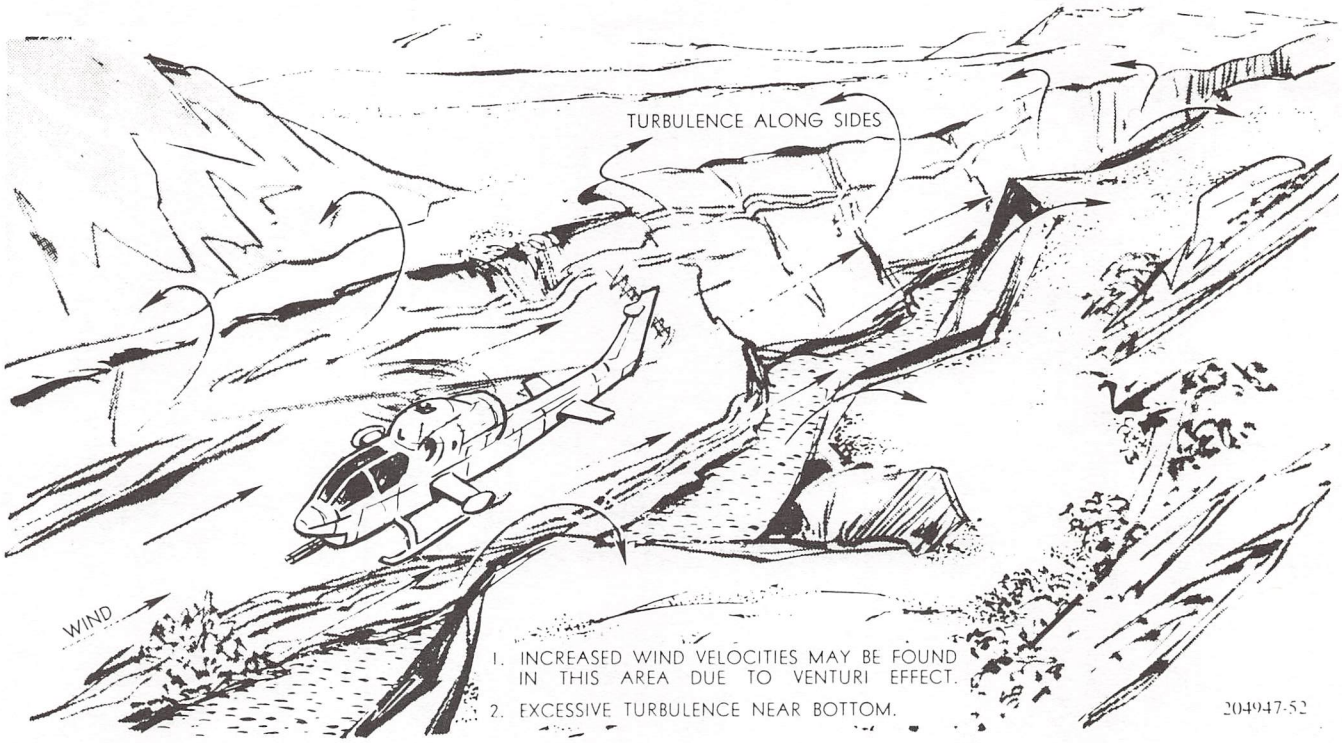


Figure 6-4. Wind Effect In Valleys Or Canyons

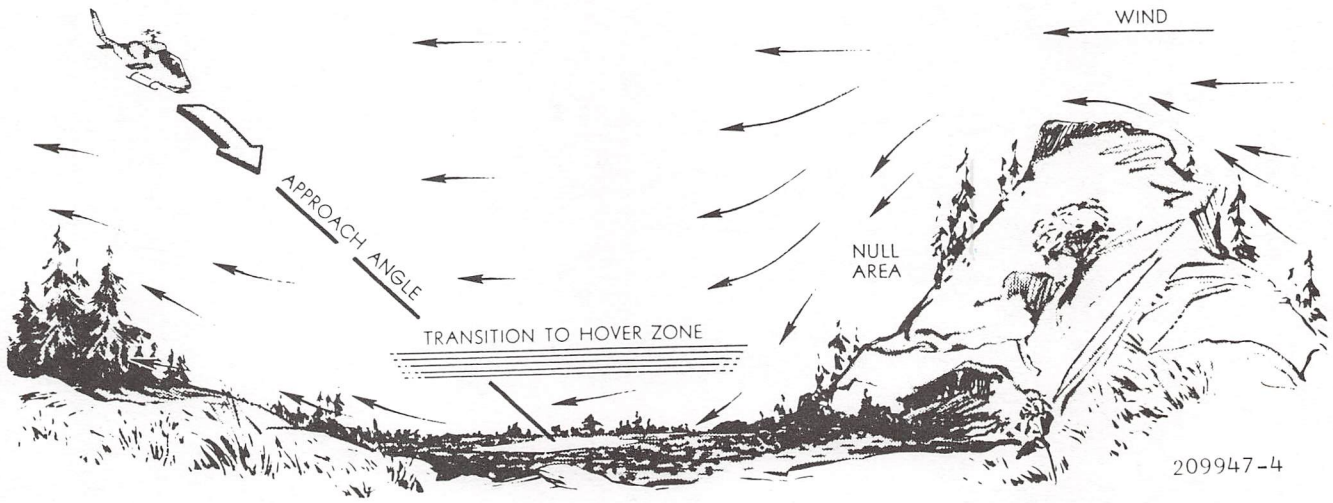


Figure 6-5. Wind Effect in Confined Area

SECTION VII — COMMUNICATIONS — NAVIGATION EQUIPMENT AND PROCEDURES

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Communications — Navigation — Identification System 7-1

COMMUNICATIONS — NAVIGATION — IDENTIFICATION SYSTEM.

Introduction.

The communications-navigation equipment for the AH-1T (TOW) helicopter include a FM(AN/ARC-114A) radio coupled with a TSEC/KY-28 voice security unit. The helicopter has a UHF(AN/ARC-159(V)1) coupled with a TSEC/KY-28 voice security unit, and the UHF direction finder (AN/ARA-50). Helicopter intercommunication is controlled with (AN/AIC-18). The helicopter is equipped with identification radar (AN/APX-72) radar beacon (AN/APN-154(V), radar altimeter (AN/APN-171(V), compass set (AN/ASN-75B), automatic direction finder (ADF) (AN/ARN-83) and TACAN (AN/ARN-84(V)). The primary navigation instrument is the bearing distance heading indicator which responds to the ADF, UHF and TACAN units.

For antennas and their location see figure 7-1. Only the antennas which the pilot can visually check for damage are shown.

AN/ARC-114A FM Radio Set.

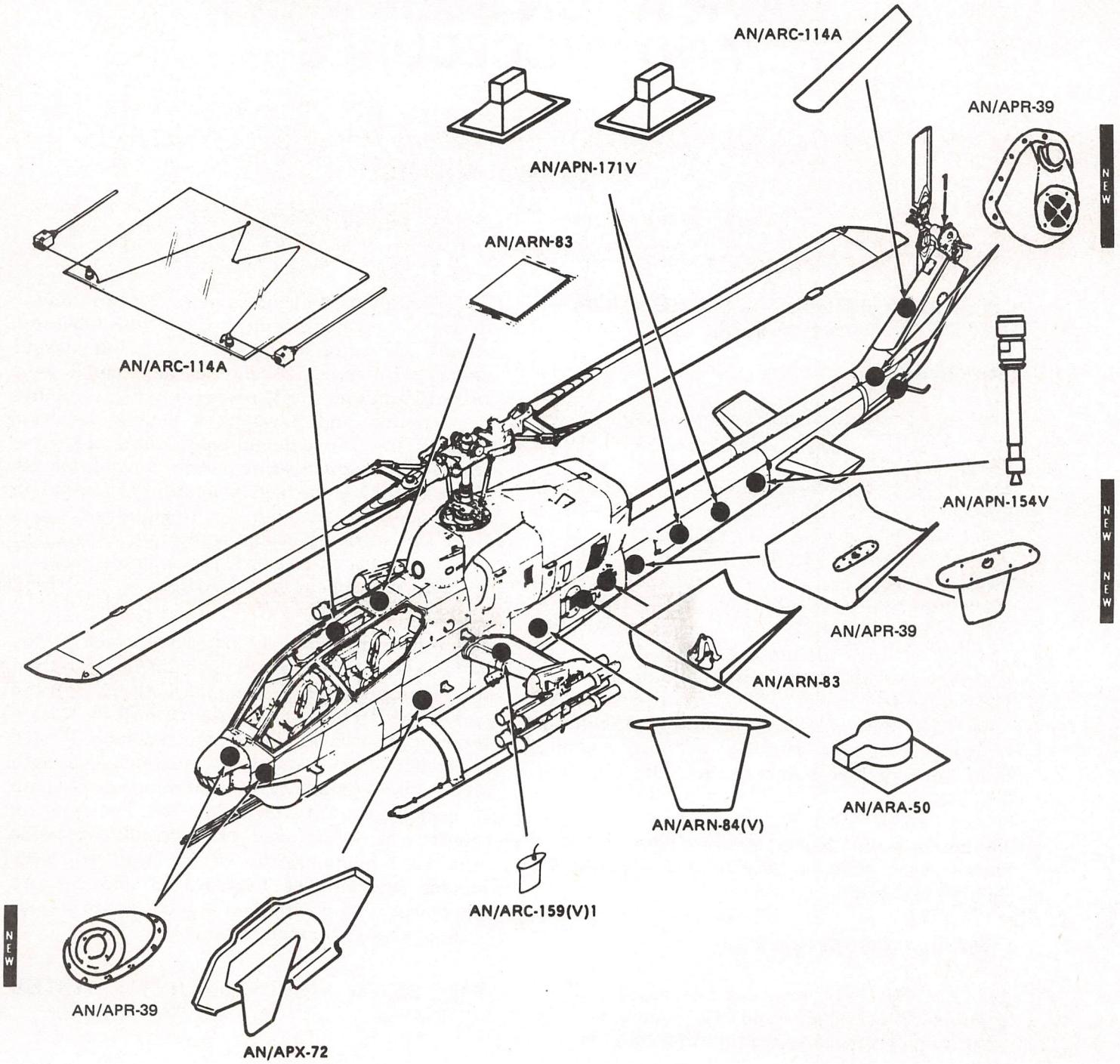
The AN/ARC-114A provides two-way frequency modulated (FM) narrow band voice communications, with homing capability, in the frequency range of 30.00 to 75.95 MHz (figure 7-2). However, homing is primarily in the 30.00 to 60.00 MHz range. The set operates on 920 channels for a distance of approximately 50 miles as limited by line of sight. FM homing information is presented to the course displacement pointer (bug) and signal strength on the vertical displacement pointer on the pilot Attitude Direction Indicator (ADI).

The FM facility in conjunction with FM homing antenna, develops course deviation (steering) signal, FM signal adequacy, and station passage signals. Receiver RF signals are routed from homing antenna to FM radio set which compares two signals and develops a course deviation signal. This course deviation signal is applied to the ADI left-right steering pointer. In addition, RF input to FM radio set is monitored, output or monitoring circuit is applied to signal adequacy flag, and station passage pointer on ADI. In the event of power failure or loss of homing signal, a red flag will appear on the ADI.

The course displacement pointer (located at the bottom of the ADI) indicates left-right deviation from the homing station. Flying the helicopter to the pointer will return the pointer to null (on course heading). The vertical displacement pointer (located on the left side of the ADI) indicates signal strength and station passage. The pointer moves up with increasing signal strength. The FM homing information is displayed automatically when the ARC-114A mode selector switch is placed in the homing position. The TSEC/KY-28 voice security equipment is used with the FM Radio Set to provide secure two-way communications.

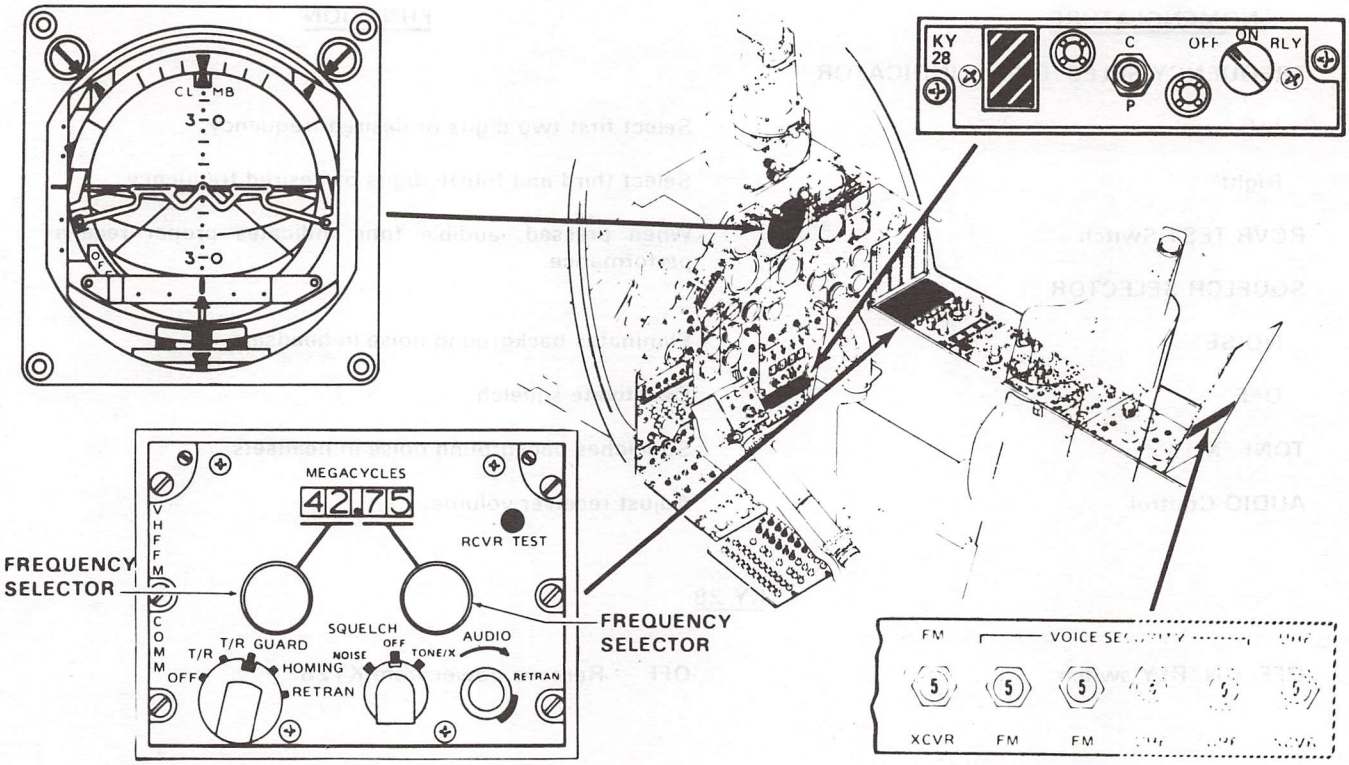
TSEC/KY-28 VOICE SECURITY SYSTEM (VHF-FM).

With the KY-28 equipment installed, received audio is controlled by the KY-28 control (figure 7-2). In voice security operation, encoded signals picked up by VHF communication antenna are applied to the VHF receivers. In the radio set receiver, signals are selected, amplified and converted to coded audio signals. Coded audio signals are then applied to



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Figure 7-1. Antenna Location



NOMENCLATURE	FUNCTION
FUNCTION SELECTOR	
OFF	Power off.
T/R	Receiver — ON; Transmitter — Standby
T/R GUARD	Guard receiver — ON; Transmitter — Standby; Receiver — ON
	NOTE Reception on the guard receiver is unaffected by frequencies selected for normal communications.
	NOTE The guard frequency can be selected on the main receiver.
HOMING	Activates the homing mode and displays on attitude indicator. May also be used for normal voice communications. The communications antenna is automatically selected when the transmitter is keyed.
RETRAN	Not used.

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Figure 7-2. F M Radio (Sheet 1 of 2)

NOMENCLATURE	FUNCTION
FREQUENCY SELECTORS — INDICATOR	
Left	Select first two digits of desired frequency.
Right	Select third and fourth digits of desired frequency.
RCVR TEST Switch	When pressed, audible tone indicates proper receiver performance.
SQUELCH SELECTOR	
NOISE	Eliminates background noise in headsets.
OFF	Deactivate squelch.
TONE/X	Squelches background noise in headsets.
AUDIO Control	Adjust receiver volume.
KY-28	
OFF/ON/RLY switch	OFF — Remove power from KY28
	ON — Applies power to KY28.
	RLY — Not used.
C/P switch	C — Permits ciphered communication on the radio set.
	P — Permits unciphered communication on the radio set.
Zeroize switch (under stripper cover)	Aft — Allows normal operation.
	Forward — Placed in the forward position during emergency situations to neutralize and make inoperative the associated KY-28 cipher equipment. Do not place the zeroize switch in the forward position unless a crash or capture is imminent.

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Figure 7-2. F M Radio (Sheet 2 of 2)

KY-28 Coder (VHF) for translation to clear voice audio. The resulting decoded audio output is applied to impedance matching network. Impedance matching network loads and distributes decoded audio to pilot and copilot/gunner ICS control for selection. When VHF monitor switch setting is made, audio is amplified in the ICS control. Audio signal level is further adjusted by the ICS control volume (VOL). The decoded audio signal is then routed to pilot or copilot/gunner headset.

With the KY-28 installed, transmitted audio signals are used in conjunction with the VHF facility to provide secure, two-way voice communications. The encoder portion of the KY-28 coder (VHF) translates the microphone audio to coded voice for application to the VHF transmitter. Secure audio signal from the VHF radio transmitter is sent to ground or air station KY-28 coder (VHF) for translation to clear voice.

AN/ARC-114A FM Radio Set Operating Procedures.

1. FM XCVR circuit breaker — CLOSED.
2. VOICE SECURITY FM circuit breakers — CLOSED.
3. BATTERY switch — ON.
4. ICS transmit select — FM.
5. ICS monitor FM — ON.
6. ICS VOL control — AS REQUIRED.
7. Function selector — AS REQUIRED.
8. Frequency selector — AS REQUIRED.
9. SQUELCH — AS REQUIRED.
10. AUDIO — ADJUST.
11. RCVR TEST — PRESS.

KY-28

1. RLY switch — ON.
2. C/P switch — AS REQUIRED.

AN/ARC-159 (V) 1 UHF Radio Set

The AN/ARC-159 Radio Set is a solid state UHF transceiver that provides two-way amplitude-modulated communication capability (figure 7-3). The radio set permits transmitting and receiving on any of 7,000 frequencies, spaced 25-KHz apart. In addition, the radio set is capable of wide-band data (secure) communication, guard frequency reception, and direction finder (DF) reception. The guard receiver module is a self-contained fix tuned receiver, set to some frequency between 238.000 and 248.000 MHz (usually 243.000 MHz) and can operate simultaneously with the main receiver. During DF reception, the radio set receives RF signals from the DF antenna and routes the demodulated low frequencies to the DF amplifiers and number 1 pointer of BDH indicators. The control panel, located at the front of the radio set, provides for frequency selection. Any 1 of 20 preset frequency channels or any one of the 7,000 frequencies within the range of the radio set may be selected. The copilot/gunner has a guarded EMER UHF switch mounted on the canopy frame. Activating the switch preempts any other setting and places the system at 243.000 MHz.

UHF Radio Set Operating Procedure.

1. ICS PLT and GUNNER circuit breakers — CLOSED.
2. UHF XCVR circuit breaker — CLOSED.
3. VOICE SECURITY UHF circuit breakers — CLOSED.
4. BATTERY Switch — ON.
5. ICS transmit select — UHF.
6. ICS monitor UHF — ON.
7. ICS VOL control — AS REQUIRED.
8. UHF function selector — BOTH.
9. UHF frequency selectors or PRESET — AS REQUIRED.
10. UHF VOL control — AS REQUIRED.
11. UHF SQUELCH — ON.
12. Depress and release UHF TONE — 1020 Hz TONE IS HEARD.
13. Mode selector — AS REQUIRED.

UHF Direction Finder (AN/ARA-50).

The direction finder group AN/ARA-50 is controlled by the function selector switch on the UHF control panel in ADF position (figure 4-3). System operates in the frequency range of 225 to 339.95 MHz. Short or

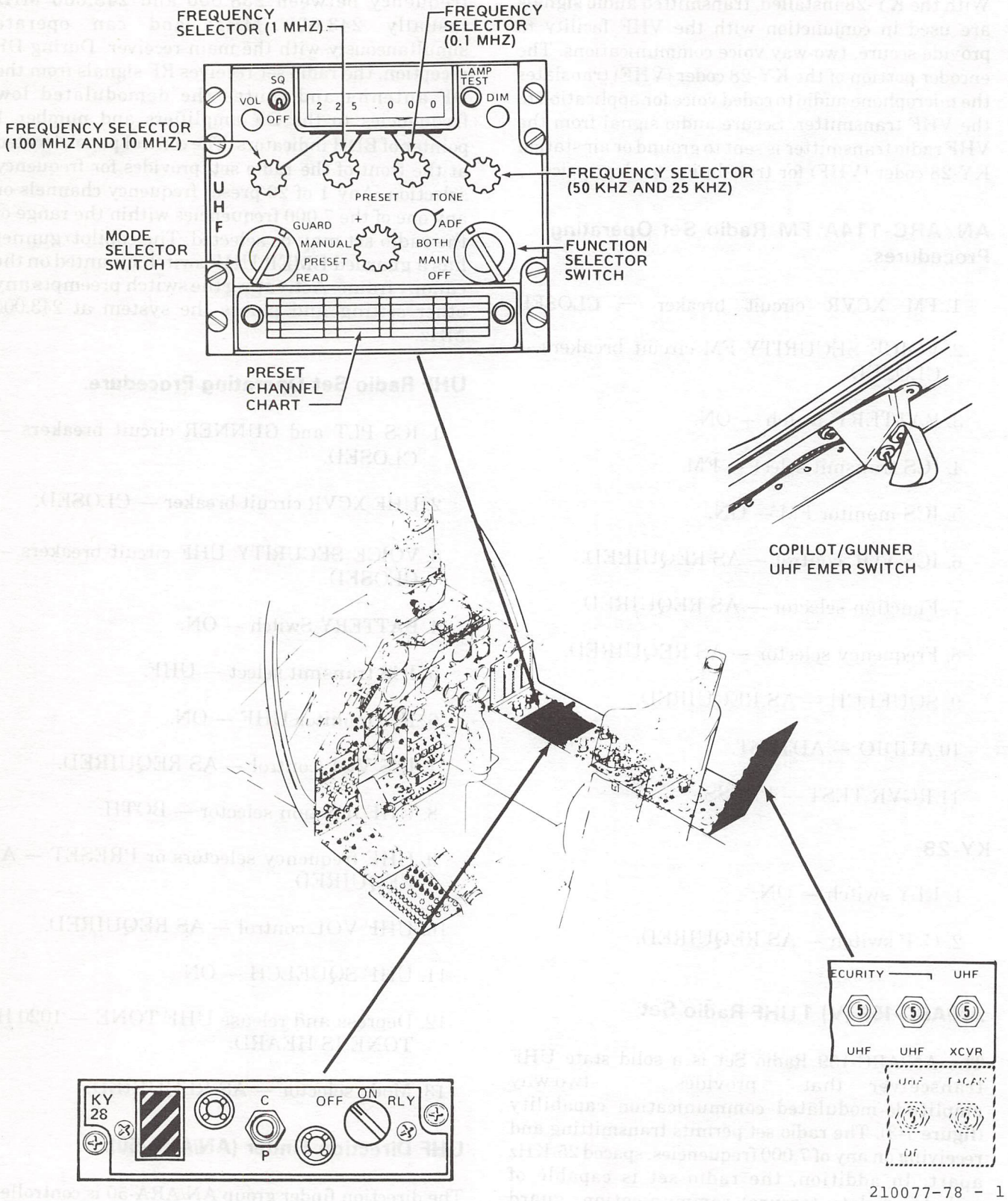


Figure 7-3. UHF Radio (Sheet 1 of 3)

NOMENCLATURE	FUNCTION
DIM control	Adjusts light intensity of LED frequency display.
LAMP TEST control	Displays (888888) when the switch is pressed.
VOL control	Adjusts level of audio signal.
100 MHz and 10 MHz selector	Selects and indicates the manual 100 MHz and 10 MHz frequency increments in operation.
1 MHz selector	Selects and indicates the manual 1 MHz frequency increment in operation.
0.1 MHz selector	Selects and indicates the manual 0.1 MHz frequency increment in operation.
50 KHz and 25 KHz selector	Selects and indicates the manual 50 KHz and 25 KHz frequency increments in operation.
TONE control switch	With TONE control (depressed), the transmitter will transmit a 1020 Hz tone signal.
SQ—OFF switch	Enables or disables main receiver squelch.
Mode selector switch	Determines frequency selection and indicates frequency and/or channel selection.
GUARD	Shifts transceiver to guard channel frequency, 243.000 MHz and displays 243.000 MHz on readout. Both the preset and manual frequencies are ineffective.
MANUAL	Permits manual selection of any one of 7,000 frequency channels by use of the manual frequency selectors. The frequency selected is displayed on the readout indicator. In this position the preset channel selector control is ineffective.
PRESET	Permits selecting one of 20 preset channels with the preset channel control and displays the channel on the readout indicator by the 4th and/or 5th lamp. In this position the manual selectors are ineffective.
READ	Permits the operator to read the frequency of the selected preset channel. In this position the preset frequency is displayed on the readout indicator.
Chart	Provides a semipermanent reference for all preset operating frequencies set on the memory drum.
PRESET	Selects any one of 20 preset frequency channels when the mode selector is in the PRESET position.
Function selector switch	Select mode of operation.
OFF	Removes power from radio set.
MAIN	Equipment is in a transceiver mode of operation. In normal condition (key switch not actuated) the equipment is in the receive condition.
BOTH	Equipment is energized in the same way as described for the MAIN position. In addition, the guard receiver is turned on.
ADF	AN/ARA-50 direction finding equipment associated with AN/ARC-159 Radio Set becomes operative. Both the main and guard receivers are enabled.

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Figure 7-3. UHF Radio (Sheet 2 of 3)

KY28

NOMENCLATURE	FUNCTION
OFF/ON/RLY switch	OFF — Remove power from KY28. ON — Applies power to KY28. RLY — Not used.
C/P switch	C — Permits ciphered communication on the radio set. P — Permits unciphered communication on the radio set.
Zeroize switch (under stripper cover)	Aft — Allows normal operation. Forward — Placed in the forward position during emergency situations to neutralize and make inoperative the associated KY-28 cipher equipment. Do not place the zeroize switch in the forward position unless a crash or capture is imminent.

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Figure 7-3. UHF Radio (Sheet 3 of 3)

long range of the DF set is selected by positioning the UHF-DF RANGE switch (figure 7-4) on the center section of the instrument panel, to LONG or SHORT. When the function selector switch is at the ADF position and a frequency of 225 to 339.95 MHz is selected, the UHF receiver is coupled to the direction finder group and bearing information to the station emitting the signal, and is presented on the No. 1 pointer of the BDH indicator.

UHF Direction Finder Operating Procedure.

1. UHF DF circuit breakers — CLOSED.
2. Frequency selector knobs — POSITION (to desired frequency.)
3. Function selector — ADF.
4. DF RANGE — POSITION (to LONG or SHORT as required.)

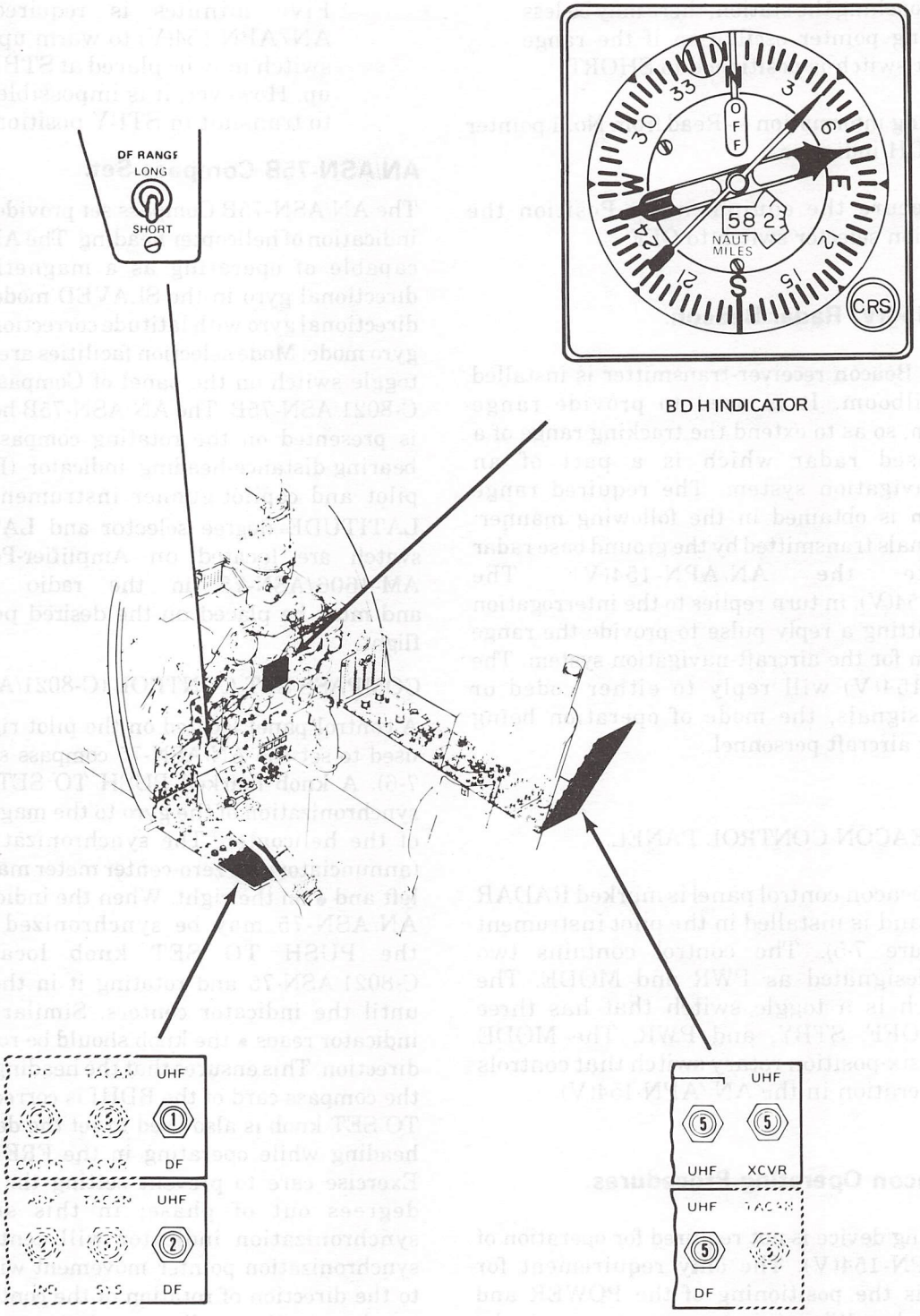


Figure 7-4. UHF Direction Finder

NOTE

Approaching the station, there may be less bearing pointer oscillation if the range select switch is positioned to SHORT.

5. Bearing information — Read from No. 1 pointer on BDH indicator.

6. To secure the equipment — Position the function selector switch to OFF.

AN/APN 154(V) Radar Beacon.

The Radar Beacon receiver-transmitter is installed in the tailboom. It is used to provide range information, so as to extend the tracking range of a ground-based radar which is a part of an aircraft-navigation system. The required range information is obtained in the following manner: X-band signals transmitted by the ground base radar interrogate the AN/APN-154(V). The AN/APN-154(V), in turn replies to the interrogation by transmitting a reply pulse to provide the range information for the aircraft-navigation system. The AN/APN-154(V) will reply to either coded or noncoded signals, the mode of operation being selected by aircraft personnel.

RADAR BEACON CONTROL PANEL.

The radar beacon control panel is marked RADAR BEACON and is installed in the pilot instrument panel (figure 7-5). The control contains two switches designated as PWR and MODE. The PWR switch is a toggle switch that has three positions: OFF, STBY, and PWR. The MODE switch is a six-position rotary switch that controls mode of operation in the AN/APN-154(V).

Radar Beacon Operating Procedures.

An indicating device is not required for operation of the AN/APN-154(V). The only requirement for operation is the positioning of the POWER and MODE switches. When it is necessary to operate the equipment:

1. PWR — PWR.

2. MODE — AS REQUIRED.

NOTE

Five minutes is required for the AN/APN-154(V) to warm up. The PWR switch may be placed at STBY for warm up. However, it is impossible for the set to transmit in STBY position.

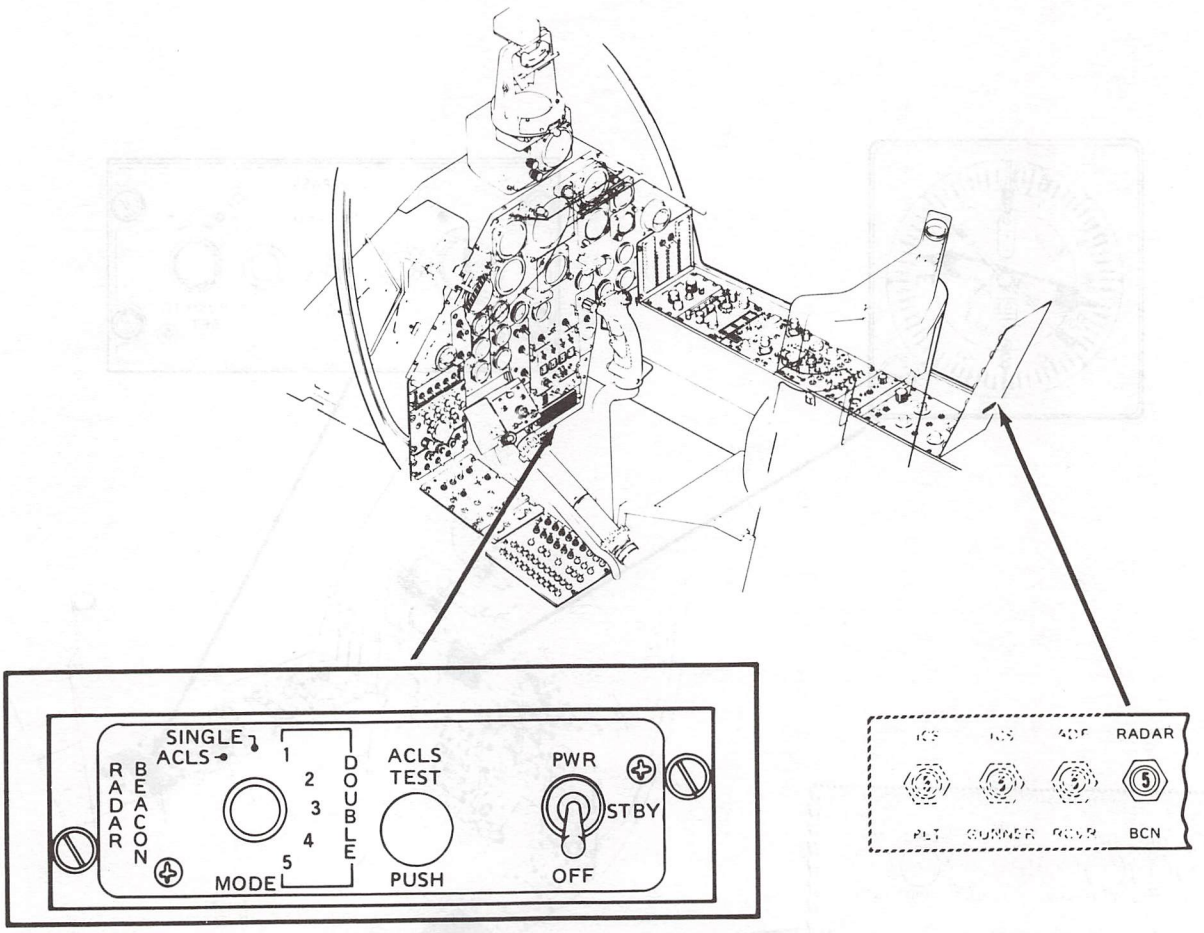
AN/ASN-75B Compass Set.

The AN/ASN-75B Compass set provides an accurate indication of helicopter heading. The AN/ASN-75B is capable of operating as a magnetically slaved directional gyro in the SLAVED mode, or as a free directional gyro with latitude correction in the FREE gyro mode. Mode selection facilities are provided by a toggle switch on the panel of Compass Set Control C-8021/ASN-75B. The AN/ASN-75B heading output is presented on the rotating compass card of the bearing-distance-heading indicator (BDHI) on the pilot and copilot/gunner instrument panel. The LATITUDE degree selector and LATITUDE N-S switch are located on Amplifier-Power Supply AM-4606/ASN-75 in the radio compartment and must be placed on the desired position before flight.

NEW NEW

COMPASS SET CONTROL (C-8021/ASN-75B).

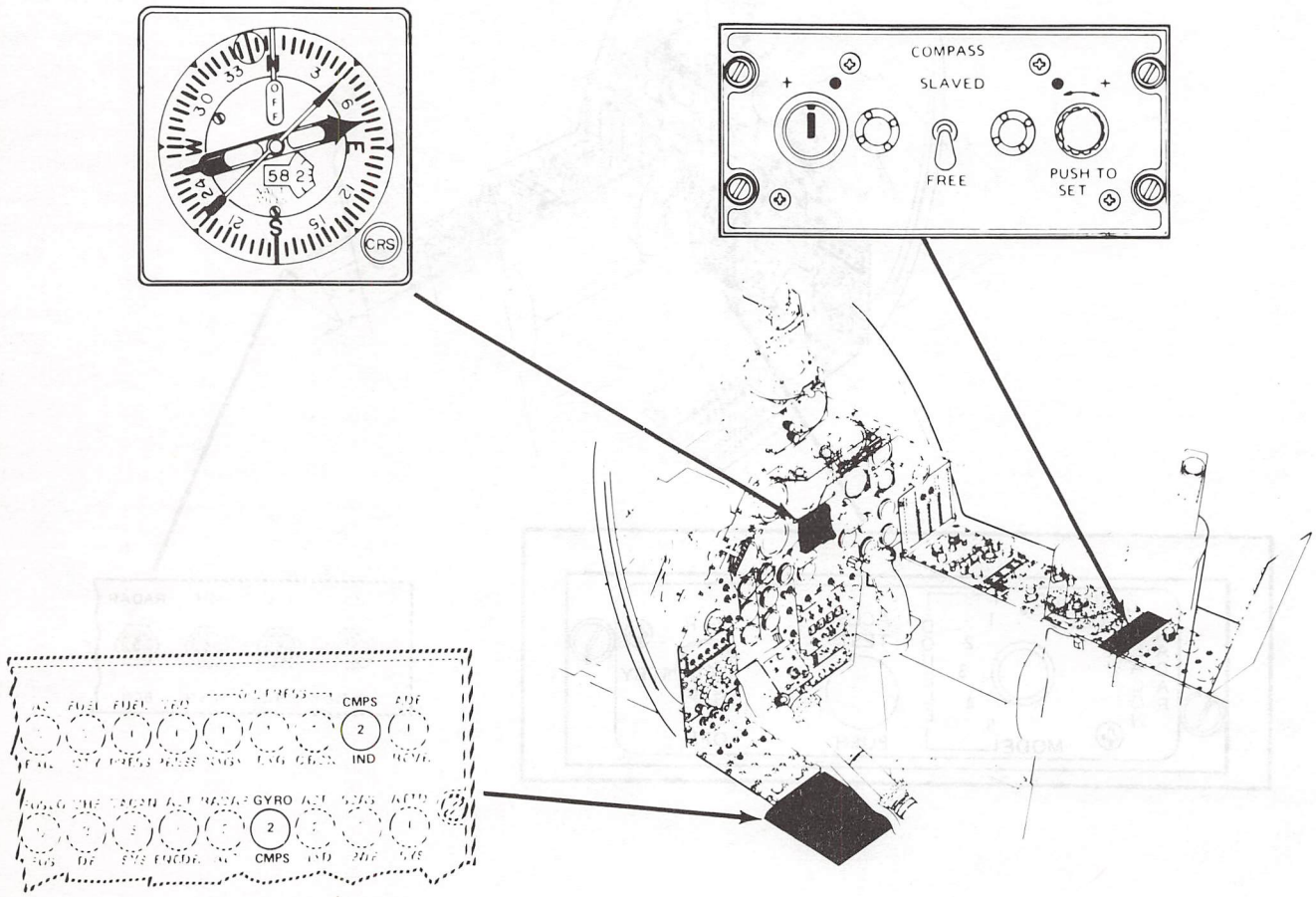
A control panel located on the pilot right console is used to set the AN/ASN-75 compass system (figure 7-6). A knob marked PUSH TO SET provides for synchronization of the gyro to the magnetic heading of the helicopter. The synchronization indicator (annunciator) is a zero-center meter marked + on the left and • on the right. When the indicator reads +, AN/ASN-75 may be synchronized by pressing the PUSH TO SET knob located on the C-8021/ASN-75 and rotating it in the + direction until the indicator centers. Similarly, when the indicator reads • the knob should be rotated in the • direction. This ensures that the heading presented on the compass card of the BDHI is correct. The PUSH TO SET knob is also used to set the desired aircraft heading while operating in the FREE gyro mode. Exercise care to prevent setting the compass 180 degrees out of phase; in this situation the synchronization indicator will center; however, synchronization pointer movement will be opposite to the direction of rotation of the control knob. The synchronization indicator continues to provide a visual check on the slaving operation. The AN/ASN-75 compass system receives power from the 26 volt ac bus and the 115 volt ac bus. Circuit protection is provided by a circuit breaker in the circuit breakers panel labeled GYRO CMPS and CMPS IND.



NOMENCLATURE	FUNCTION
PWR switch	STBY position — power to AN/APN-154(V) is turned on but no output is obtainable from receiver/transmitter due to disabling of decoder.
	POWER position — encoder is enabled permitting normal operation of AN/APN-154(V).
	OFF position — primary input power to set is turned off.
MODE switch	SINGLE position — set will reply to single pulse (non-coded) interrogations.
	DOUBLE position — (5 positions) the set will reply only to properly coded double-pulse interrogations that correspond to code determined by setting of Mode switch.
ACLS test switch	ACLS test switch not used (for auxiliary KA band equipment).

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Figure 7-5. Radar Beacon



NOMENCLATURE	FUNCTION
PUSH TO SET knob	Provides synchronization of gyro to magnetic heading of helicopter.
SLAVED mode	Will produce an output from transmitter synchro which agrees with Remote Compass Transmitter Type ML-1 magnetic heading.
FREE gyro mode	Provides correction for earth's rate of drift by Amplifier-Power Supply AM-4606/ASN-75.

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Figure 7-6. Compass Set

NOTE

When the SLAVED mode is selected, the AN/ASN-75 will automatically slave to the correct heading at a rate of 2.5 ± 1.25 degrees per minute. The correct heading may be immediately selected with the PUSH TO SET knob as explained above. Once the correct heading is selected, the AN/ASN-75 will maintain the correct magnetic heading on the BDHI compass card.

When operating in areas of high latitude or during ship board operations, the gyro may be unslaved to prevent unreliable readings.

Slaved Gyro Operating Procedures.

1. Allow approximately two minutes for gyro to reach operating speed.
2. Mode — SLAVED.
3. PUSH TO SET knob — Synchronize gyro and magnetic heading by pushing in on knob and rotating until synchronizing indicator is centered.

Free Gyro Operating Procedures.

1. Check LATITUDE selectors and N-S switch before flight.
2. Allow approximately two minutes for gyro to reach operating speed.

NEW

3. Mode — FREE.

Intercommunications System (AN/AIC-18).

The intercommunications system provides interphone communication between the pilot and copilot/gunner within the helicopter (figure 7-7). It also provides integrating facilities for the communication and electronic equipment. An interphone disconnect is provided on each wing tip. When the microphone at the right crew station is keyed it connects the right station to the pilot microphone circuit. When the microphone at the left crew station is keyed it connects the left side station to the copilot/gunner microphone circuit. Subsequently, if a transmitter is keyed at the pilot or copilot/gunner station, and the microphone at the right or left crew station is keyed that station would also be put on the air through the respective ICS amplifier.

INTERCOMMUNICATION CONTROL PANEL.

NEW

An INTER control panel is installed in the left side of the pilot instrument panel and one is installed forward of the copilot/gunner seat. The control panel contains seven monitor switches (six of which are utilized), a HOT MIC switch, CALL switch, and VOLume control. Transmitter selector switch is located in the lower center section of control panel.

Associated with the AN/AIC-18 is the press-to-talk switch located on top of the pilot and copilot/gunner cyclic stock grip. It is a 4 position switch but only the forward and aft position are utilized. Pressing forward keys the radio, aft keys the ICS. The copilot/gunner has a footswitch for keying the intercommunications system or radio, as selected by the rotary selector switch.

Interphone Operating Procedures.

NEW

1. INTER PLT and ICS gunner circuit breakers — CLOSED.
2. Monitor — PULL AND ROTATE.
3. Transmitter selector — AS DESIRED.
4. VOLume control — ADJUST.
5. Press-to-talk — RADIO/ICS.

AN/APX-72 Identification Transponder.

NEW NEW NEW NEW NEW

The AIMS Transponder system is composed of a transponder (RT859/APX-72), a transponder control panel (C-16280(P)/APX), an indicator/encoder (AAU-21A), an on board transponder self-test set (TS-1843/APX), transponder computer (KIT-1A/TSEC), and an antenna. The system provides IFF identification in response to coded interrogations from ground, seaborne or airborne stations. In addition, the signal returned from the IFF transponder can be used by the interrogating station to determine range and azimuth information. Modes 1 and 2 are used for military control purposes. Mode 3/A is the

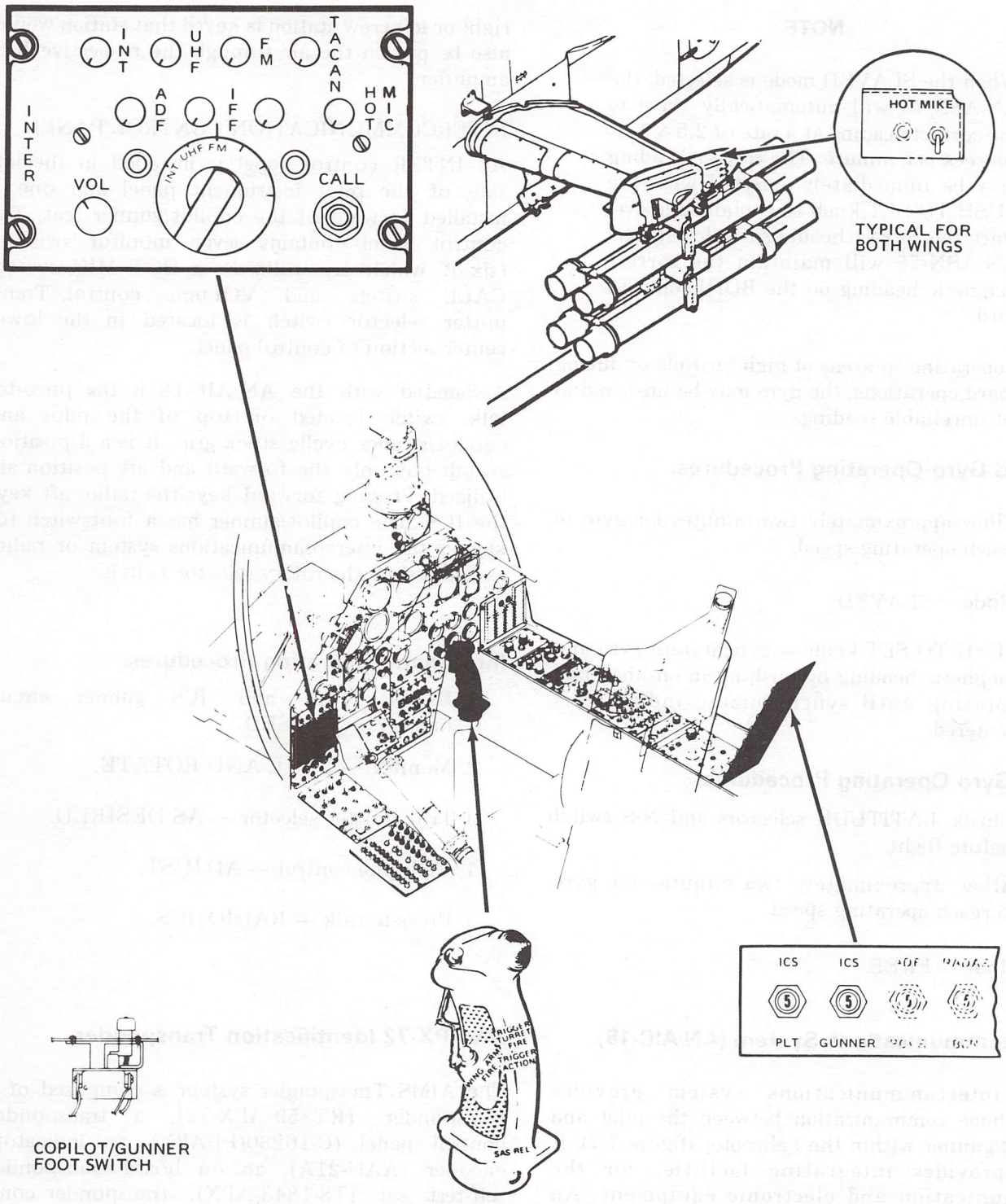


Figure 7-7. Intercommunications Systems (Sheet 1 of 2)

NOMENCLATURE	FUNCTION
Monitor switches INT, UHF, FM, TACAN, ADF and IFF	Monitor the communication they represent. Any combination or all of switches may be in on position at one time for monitoring.
HOT MIC switch	Enable operator to conduct hand free intercommunications.
CALL switch	Provides emergency intercommunications on the call audio line, regardless of the position of switches on the other station.
Transmitter Selector switch (Marked INT, UHF, FM)	Enables operation and modulation of UHF and FM transmitters also provides audio monitoring and side-tone from the associated receiver. INT position permits intercommunication between pilot and copilot, gunner. (The Press-to-Talk switch on the cyclic stick grip must be in the ICS or radio position to talk.
VOL control	Vary audio level in headset.
Press-to-Talk	Switch forward position keys the selected transmitter or the interphone system if INT is selected on transmitter selector switch. Aft position keys the interphone circuit regardless of position of transmitter selector switch.
Copilot/Gunner Foot switch	Used to key selected transmitters. Key intercommunications system if transmitter selector switch is in INT position.

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Figure 7-7. Intercommunications Systems (Sheet 2 of 2)

common military/civilian mode and is used by the FAA for air traffic control purposes. On helicopters modified by AFC-80, mode C is the altitude reporting mode. With the M-C switch in the ON position, it provides automatic reporting of pressure altitude to ground stations. This information is provided by the pilot's altitude indicator/encoder. Mode 4 is the secure (encrypted) military identification mode, and is operational only when the computer KIT-1A/TSEC is installed.

The transponder, control panel, set-test and altimeter vibrators receive 28 volt dc power from the dc essential bus. The transponder and control panel are protected by the IFF XPONDER circuit breaker. The self-test set is protected by an adjacent circuit breaker labeled IND ALTM VIB. AC power is furnished by the 115 volt ac essential bus. The altimeter encoder is protected by the ALT ENCDR circuit breaker and the transponder computer is protected by the IFF CMPTR circuit breaker. To ensure reliable operation, a one minute stabilization period is recommended with the rotary master switch in STBY position prior to system operation.

TRANSPONDER CONTROL PANEL.

The transponder control panel C-6280(P)/APX (figure 7-8) is located in the pilot's right console and contains all the operating controls with the exception of the IFF code hold switch. The five position rotary master selector switch controls operation of the system as follows:

OFF — Identification system is de-energized.

STBY — Full power supplied to the system, but interrogation is blocked.

LOW — Receiver sensitivity is reduced by preset amount, permitting only high energy signals to trigger the transponder.

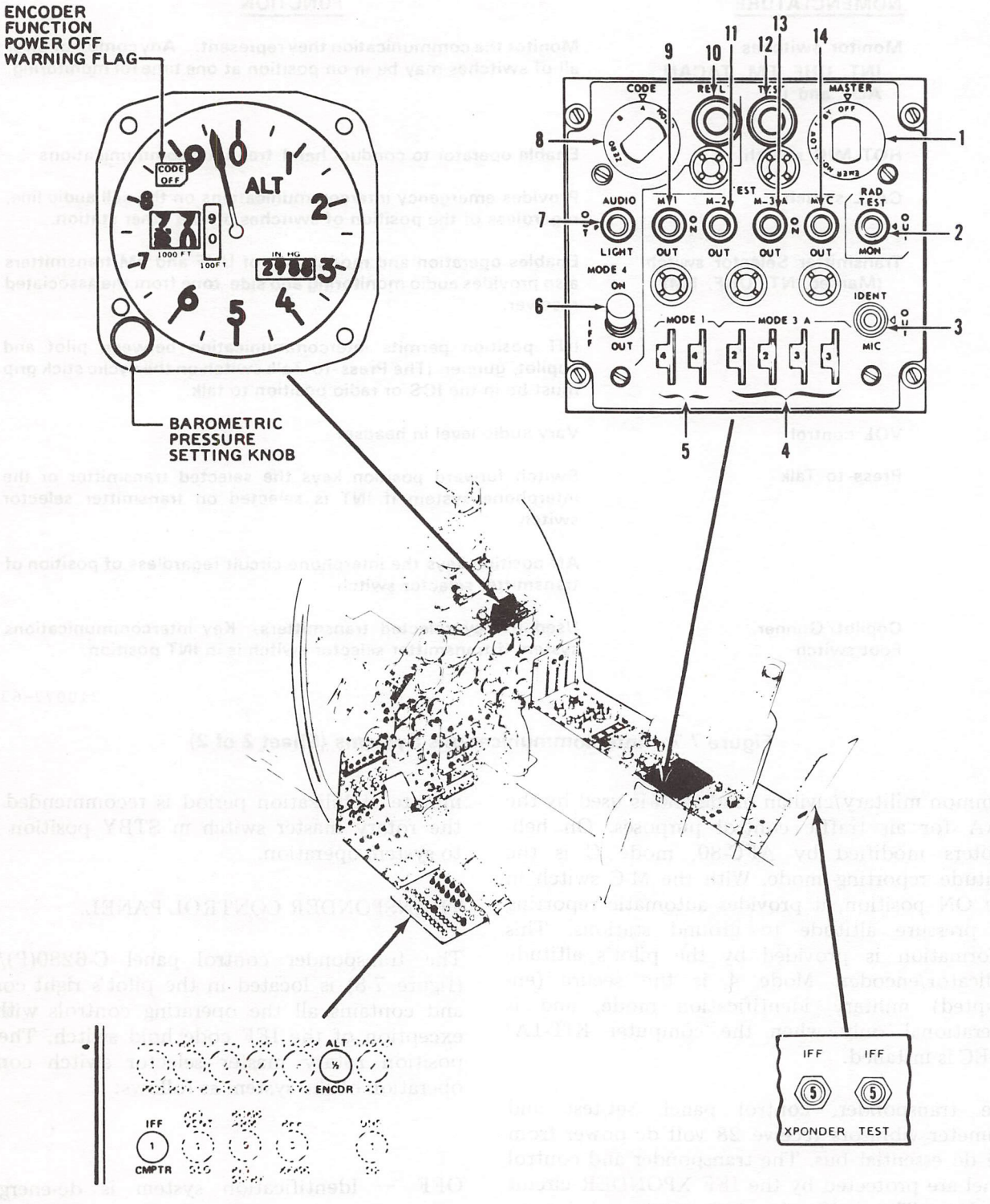


Figure 7-8. Identification Transponder (Sheet 1 of 3)

	NOMENCLATURE		FUNCTION
1.	MASTER Control	OFF	Turns set off.
		STBY	Places in warmup (standby) condition.
		LOW	Set operates at reduced receiver sensitivity.
		NORM	Set operates at normal receiver sensitivity.
		EMER	Transmits emergency reply signals to MODE 1, 2, or 3/A interrogations regardless of mode control settings.
2.	RAD TEST — MON Switch	RAD TEST	Enables set to reply to TEST mode interrogations. Other functions of this switch position are classified.
		MON	Enables the monitor test circuits.
		OUT	Disables the RAD TEST and MON features.
3.	IDENT-MIC Switch	IDENT	Initiates identification reply for approximately 25 seconds.
		OUT	Prevents triggering of identification reply. Spring loaded to OUT.
		MIC	Initiates identification reply for approximately 25 seconds when the AN/ARC-159 transmitter is keyed.
4.	MODE 3/A Code Select Switches		Selects and indicates the MODE 3/A four-digit reply code number.
5.	MODE 1 Code Select Switches		Selects and indicates the MODE 1 two-digit reply code number.
6.	MODE 4 Switch	ON	Enables the set to reply to MODE 4 interrogations.
		OUT	Disables the reply to MODE 4 interrogations.
7.	AUDIO-LIGHT Switch	AUDIO	Enables aural and REPLY light monitoring of valid MODE 4 interrogations and replies.
		LIGHT	Enables REPLY light only monitoring of valid MODE 4 interrogations and replies.
		OUT	Disables aural and REPLY light monitoring of valid MODE 4 interrogations and replies.
8.	CODE Control		Functions of this switch are operationally classified.
9.	M-1 Switch	ON	Enables the set to reply to MODE 1 interrogations.
		OUT	Disables the reply to MODE 1 interrogations.
		TEST	Provides test of MODE 1 interrogations by indication on TEST light.

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Figure 7-8. Identification Transponder (Sheet 2 of 3)

	NOMENCLATURE		FUNCTION
10.	REPLY Indicator		Lights when valid MODE 4 replies are present, or when pressed.
11.	M-2 Switch	ON	Enables the set to reply to MODE 2 interrogations.
		OUT	Disables the reply to MODE 2 interrogations.
		TEST	Provides test of MODE 2 interrogations by indication on TEST light.
12.	TEST Indicator		Lights when the set responds properly to a M-1, M-2. M-3/A or M-C test, or when pressed.
			NOTE Kit-1A/TSEC (classified) computer, must be installed before set will reply to a MODE 4 interrogation.
13.	M-3/A Switch	ON	Enables the set to reply to MODE 3/A interrogations.
		OUT	Disables the reply to MODE 3/A interrogations.
		TEST	Provides test of MODE 3/A interrogation by indication on TEST light.
14.	M-C Switch	ON	Enables altitude reporting in conjunction with AAU 32A.
		OUT	Disables altitude reporting function.
		TEST	Provides test feature for mode C function.

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Figure 7-8. Identification Transponder (Sheet 3 of 3)

NORM — Transponder will operate at normal sensitivity and respond to interrogations in accordance with settings of other controls.

EMER — Allows the system to respond to interrogations in modes 1,2, and 3/A regardless of the settings of the mode control toggle switches. Modes 1 and 2 will respond with codes selected on the applicable dials, plus a recognizable emergency pulse train. Mode 3/A will transmit code 7700 regardless of the code selected on the dial. Modes C and 4 will respond normally, regardless of the position of the selector switches. A detent prevents accidental selection of the EMER position and is bypassed by raising the selector knob.

The four mode control toggle switches marked M-1, M-2, M-3/A and M-C have three marked positions, OUT, ON, TEST. The OUT (down) position prevents responses and the ON (center) position permits responses in the mode selected. The spring loaded TEST (up) position provides a self-test capability in conjunction with the on board transponder self-test set. When one of the mode control toggle switches is held momentarily (2-3 sec) in the TEST position, the on board self-test set will generate interrogation pulses pairs for the mode selected. These interrogations are applied to the transponder to check for proper receiver frequency, sensitivity, and decoding. A reply from the transponder indicates that the transponder is tuned to the correct receiver frequency and has normal sensitivity. The test set analyzes the replies to ensure that spacing of bracket pulses, transmitter frequency, power, and antenna circuit VSWR (threshold for rejection) are all above the preset minimum acceptable standard. If the characteristics of the reply transmission are

within the preset limits, the test set will illuminate the TEST light on the transponder set control panel, indicating to the pilot that the AIMS Transponder System is functioning normally and a "go" condition exists. If any one or more of the transmission characteristics is not within prescribed limits, the TEST lamp will not illuminate indicating that a "NO GO" (improper operation) condition exists. The rotary master switch must be set to NORM for the test function to operate. The mode switches of the modes not being tested should be OUT when testing on the ground to prevent transponder operation on the non-tested modes. The TEST light may flash once as each mode switch is released from the TEST position, and as the RAD TEST-OUT-MON switch is moved. This is a characteristic of the transponder self test set (TS-1843/APX) and is meaningless.

The mode 1 and 3/A code selector dials are small rotatable drums with imprinted numbers which appear through the code selector windows. The numbers are changed by rotating the drums by means of the raised tabs. Mode 1 provides 32 possible combinations from 00 to 73. Mode 3/A provides 4096 possible code combinations from 0000 to 7777. Mode 2 code settings are preset on the transponder panel located in the tail boom of the aircraft. Mode 2 provides 4096 possible code combinations from 0000 to 7777.

The IDENT-OUT-MIC switch is a three position toggle switch located at the lower right corner of the transponder control panel. The spring loaded IDENT position provides an identification reply on selected modes for 15 to 30 seconds after releasing the IDENT switch. When MIC position is selected, the identification reply activation is transferred from the IDENT switch to the UHF microphone switch causing an identification reply each time the UHF microphone switch is depressed. The MIC position is not spring loaded and must be manually repositioned to OUT. The OUT position de-energizes the identification reply circuit.

The three position RAD TEST-OUT-MON toggle switch is located on the right center of the transponder control panel. The RADiated TEST position enables ground avionics maintenance personnel to test mode 3/A transponder replies when using test set interrogations from an AN/UPM-92 or similar ground test equipment. Other functions of this position are used with mode 4 test. In MON position, the switch energizes monitor circuits of the on board transponder self-test set. The TEST light will illuminate for 3 seconds each time an acceptable reply is transmitted in response to normal external interrogations in any selected mode. The OUT position de-energizes both the RAD TEST and MON circuits.

IFF CONTROL PANEL.

The IFF control panel located to the right of the pilot, contains the switches and controls for applying power and selecting the mode of operation of the transponder equipment figure 7-8.

Transponder Operating Procedure.

1. IFF XPONDER, IFF TEST and IFF CMPTR circuit breakers — CLOSED.
2. MASTER control — STBY (for 3 minutes) — LOW/NORM.
3. M-1, M-2, M-3/A, M-C and MODE 4 — ON — (unless operational requirements indicate that only specific modes will be used, then all other switches will be OUT.)
4. AUDIO-LIGHT — LIGHT.
5. IDENT-MIC — OUT.
6. RAD TEST-MON — OUT.
7. INTER IFF — ON (only when mode 4 equipment is installed and operating).
8. To secure set MASTER OFF.

Radar Altimeter – AN/APN-171(V).

The AN/APN-171(V) radar altimeter is an airborne, high resolution, short pulse, tracking and indicating radar system. The set measures and visually indicates actual clearance in feet between the helicopter and terrain, over a range from 0 to 5000 feet. The set consists of a receiver-transmitter installed in the tailboom, a receive antenna and a transmit antenna both located on the lower surface of the tailboom and a height indicator located in the pilot instrument panel. The low altitude warning will be dimmed for night operation using the caution lamp dimming switch if pilot instrument lights are on.

AN/APN-171(V) CONTROLS.

All control of the AN/APN-171(V) altimeter is centered in a single control knob located on the indicator (figure 7-9). Control functions are:

1. Low altitude warning position is selected by rotation of the low altitude set knob and indicated by a pointer traveling the outer circumference of the indicator dial.

2. System power is turned off by rotating the low altitude set knob fully counterclockwise so that the index is below zero altitude.

3. Depressing the low altitude set knob activates the system's self test feature.

Radar Altimeter Operating Procedure.

1. RADAR ALTM and RADAR ALT circuit breakers — CLOSED.

2. PUSH TO TEST knob — Rotate clockwise from off to desired LOW altitude caution light setting.

3. Test system by depressing low altitude set knob. When knob is depressed, a reading of 100 plus or minus 15 feet will be indicated if the system is functioning properly. Releasing the push to test knob restores the system to normal operation.

Bearing-Distance-Heading Indicator (BDHI).

There are two bearing-distance-heading-indicators (BDHI) mounted in the helicopter; one on the pilot instrument panel (figure 7-10) and one on copilot/gunner instrument panel. They are connected in parallel as repeaters and display the following information:

Compass Card — provides an accurate indication of the helicopter heading and is controlled by the AN/ASN-75 gyro compass system. Pointer No. 1 (single bar) displays either LF-ADF bearing from the AN/ARN-83 system or UHF-DF bearing from the AN/ARA-50. The AN/ARN-83 signal is removed from the pointer when the ADF position of the AN/ARC-159 is selected, UHF-DF bearing will be displayed only.

Pointer No. 2 (double bar) displays the TACAN bearing from the AN/ARN-84(V) system.

Digit numbers window displays the distance in nautical miles to the selected TACAN station.

AN/ARN-84 (V) TACAN.

The TACAN set is an air navigation system (figure 7-11). TACAN provides range and magnetic bearing to the selected station. The set transmits and receives radio frequency signals, demodulates and decodes the received signals, computes bearing and slant range within 300 nautical miles, processes beacon identification signals, and processes the self test signals when a self test command is initiated at the control panel.

TACAN receives on 126 channels with X or Y coding.

The bearing signal is displayed on the pilot and copilot/gunner BDHI No. 2 pointer. Line-of-sight distance range is displayed in nautical miles on the distance range indicator of each respective BDHI. The course deviation R-L and deviation warning signals are presented to the pilot on the ADI. When the VHF-FM is not in the homing mode, TACAN course deviation and flag signals will be presented on the respective pointer and flag.

AN/ARN-118 (V) TACAN.

NEW

The TACAN set is an air navigation system (figure 7-8A) which operates by transmitting and receiving radio frequency signals. The received signals are demodulated and decoded to compute slant range distance and magnetic bearing to/from the selected station. The bearing information is displayed by the No. 2 pointer on the pilot/copilot BDHI, while the line-of-sight distance range is displayed in nautical miles on the distance range indicator of each respective BDHI. The course deviation R-L and distance warning signals are presented to the pilot on the ADI. When the VHF-FM is not in the homing mode, TACAN course deviation and flag signals will be presented on the respective pointer and flag.

TACAN receives on 126 channels with X or Y coding.

The TCN-118 TACAN set contains an automatic self-test function that causes the system to be tested automatically when the TACAN beacon signal is lost. The automatic self-test checks the system for proper operation to determine if the signal loss was due to a system malfunction. If there is a system malfunction, the TEST indicator on the TACAN control panel illuminates upon completion of the automatic self-test cycle.

To provide an inflight confidence test, a manual self test can be initiated by momentarily depressing the TEST switch on the control panel. When initiating a system test, observe the control TEST indictor. If the indicator illuminated during the test and remains illuminated, there is a malfunction in the system and the information displayed on the BDHI should be disregarded. If the TEST light extinguishes, the system is checked and provides an 85 percent confidence level.

One other advantage of the TCN-118 over previous TACAN systems is that it provides both bearing and distance information in the air-to-air mode between aircraft operating with compatible systems.

The following represents operating range over level terrain:

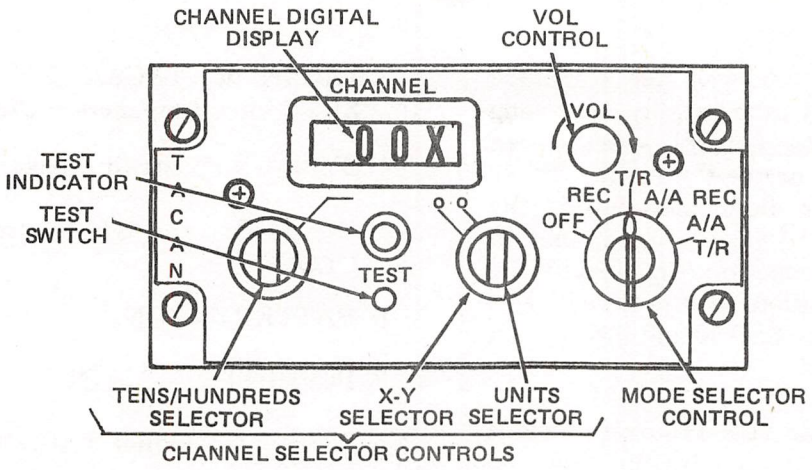
AGL (FEET)	DME
100	12
250	19
500	27
750	34
1000	39
2000	55
3000	67
4000	78
5000	87

TACAN Set — Operating Procedures.

1. ICS PLT and GUNNER circuit breakers — CLOSED.
2. CMPS and ADF IND circuit breakers — CLOSED.
3. TACAN dc, TACAN SYS ac, and TACAN XCVR circuit breakers — CLOSED.
4. GYRO CMPS circuit breaker — CLOSED.
5. INV-MAIN and STBY circuit breakers — CLOSED.
6. BATTERY — ON.
7. INVERTER — MAIN.
8. ICS control panel TACAN monitor — ON (OUT).
9. TACAN MODE selector — AS REQUIRED.
10. TACAN CHAN selectors — AS REQUIRED.

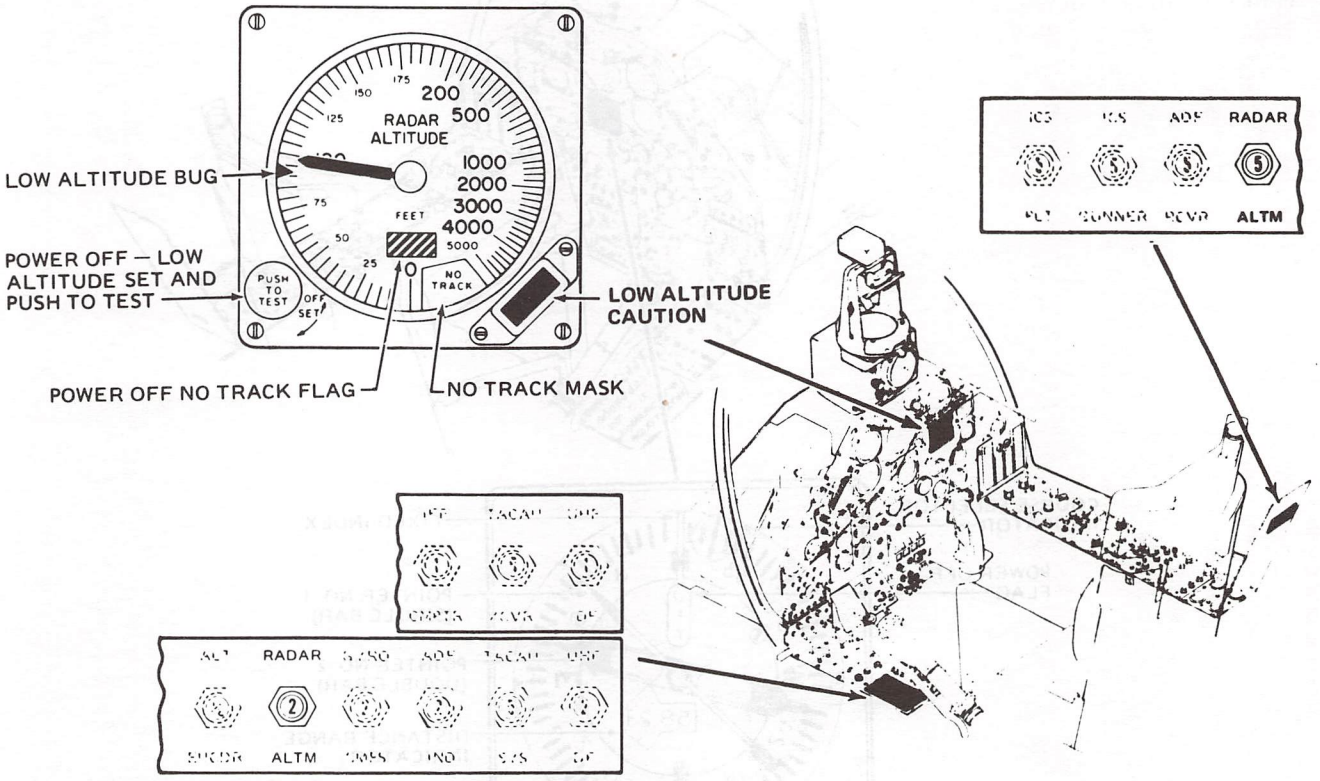
NOTE

Depressing the "BITE" switch on the TACAN control panel will interrogate the system with a test signal and provide indication of the operational condition by means of the GO-NO GO status lamps. A GO lamp indicates the system to be operational and will remain illuminated for about nine seconds. A NO GO lamp indicates that the system is not operating correctly and maintenance action is required. The NO GO lamp will remain illuminated as long as power is applied to the system.



NOMENCLATURE	FUNCTION
OFF	Off switch for TCN-118 system.
REC	Receive Mode: Provides relative bearing.
T/R	Transmit-Receive Mode: Provides bearing and distance information.
A/A REC	Air to air receive mode: receives bearing information from suitably equipped, cooperating aircraft (no distance supplied).
A/A T/R	Air to air transmit-receive mode: receives both bearing and distance information from a suitably equipped, cooperating aircraft. If the cooperating aircraft is not equipped with bearing transmitting capability, only slant range distance to the aircraft is provided.
CHANNEL selectors	Selects any of 126 channels.
X-Y	Selects either X or Y channel.
UNITS selector	Selects units digit of desired channel.
TENS/HUNDREDS	Selects tens and/or hundreds digits of desired channel.
CHANNEL digital display	Displays TACAN channel.
VOL control	Varies level of audio signal.
TEST switch	Indicates system self-test or confidence test (pilot induced).
TEST indicator	Illuminates when a malfunction occurs during either test (flashes at start of self-test cycle to check indicator lamp).

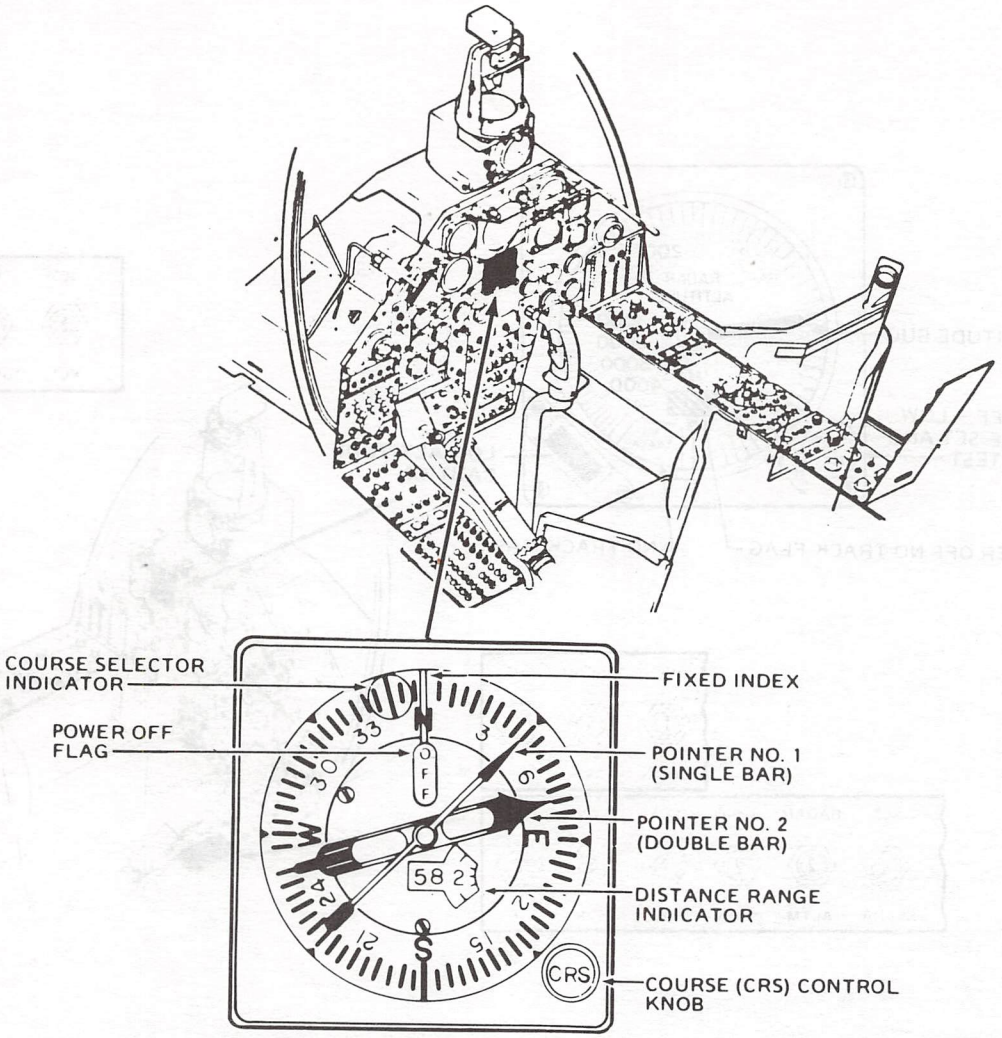
NEW NEW NEW



NOMENCLATURE	FUNCTION
Circuit breakers	Protects individual circuit.
Low altitude bug	Indicates selected altitude.
PUSH TO TEST	PUSH TO TEST — Test altimeter for operation.
	SET — Selects altitude at which low altitude warning light operates.
POWER OFF NO TRACK FLAG	OFF — Removes power. Indicates power removed from altimeter or malfunction.
NO TRACK MASK	Indicates altimeter unreliable, or above 5000 feet AGL.
LOW ALTITUDE CAUTION	Illuminates when below selected altitude.

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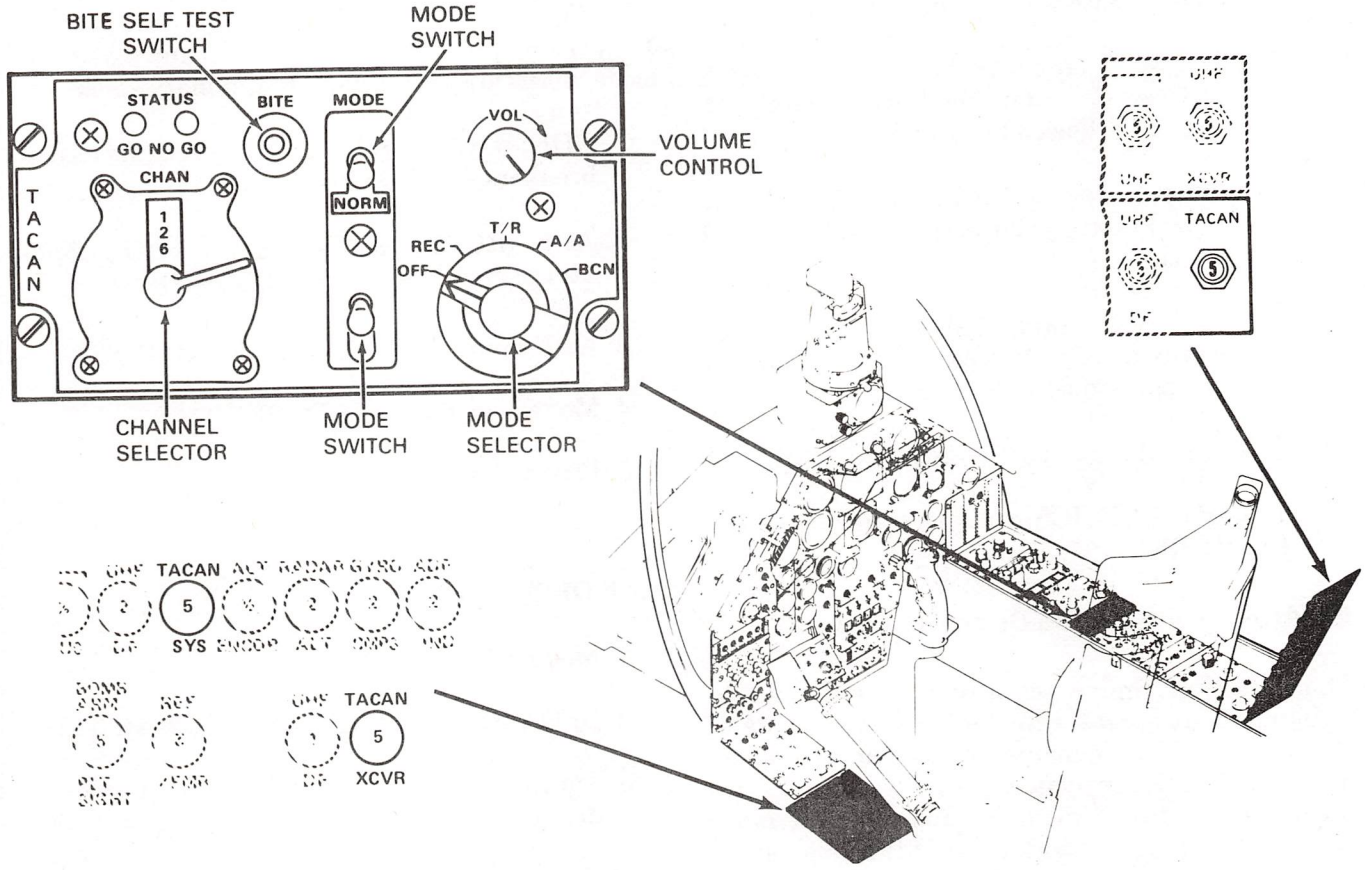
Figure 7-9. Radar Altimeter



NOMENCLATURE	FUNCTION
Power OFF Flag.	Disappears when gyromagnetic compass is energized.
Course Selector Index (BUG).	Reference for course deviation pointer on ADI.
Fixed Index	Gyromagnetic compass heading on compass card card under lubber line.
Pointer No. 1 (single bar)	Indicates ADF/UHF/DF bearing
Pointer No. 2 (double bar)	Indicates TACAN bearing.
Distance Range Indicator	Line-of-sight distance (nautical miles) to TACAN station
Course (CRS) control knob positions the bug	Positions the bug and selects course selected by the ADI deviation pointer.

210900-70A

Figure 7-10. Bearing-Distance-Heading Indicator



NOMENCLATURE	FUNCTION
STATUS lights GO NO-GO	Illuminate for nine seconds, upon completion of no-fault self-test. Illuminate, for indefinite period, when a fault occurs during selt-test.
BITE switch	Initiate self-test when depressed and released.
MODE control switches	Not used.
VOL control	Selects audio level of the beacon identity tone.
Mode selector switch REC	Receives beacon signal and computes bearing between helicopter and surface beacon.
T/R	Receives beacon signal and computes slant range and bearing between helicopter and surface beacon.
A/A	Computes slant range between two aircraft equipped with TACAN. Shall be 63 channels apart.
BCN	Becomes an omnidirectional beacon for other aircraft. (Non-functional)
CHAN selector switches	Selects any one of 126 TACAN transmit channels.

210900-146

Figure 7-11. Tacan

a. Identify tone output present for approximately 10 seconds.

b. The No. 2 bearing pointers shall indicate between 0° and 8° for approximately 15 seconds, followed by search.

c. Range between 1.6 nm and 2.0 nm for approximately 20 seconds, followed by search.

d. The GO lamp shall light after approximately 21 seconds, and remain so for approximately 9 seconds.

11. TACAN BITE — DEPRESS, RELEASE.

12. TACAN AND ICS volume controls — AS REQUIRED.

AN/ARN-83 Automatic Direction Finder.

The direction finder set provides radio aid to navigation. It operates in the frequency range of 190 to 1750 KHz. When operating as an automatic direction finder, the system presents a continuous indication of the bearing to any selected radio station. It also provides simultaneous aural reception from the station. When the manual (LOOP) mode of operation is selected, the system enables the operator to find the bearing to any selected radio station by manually controlling the null direction of the directional antenna. The system also operates as a radio range receiver and a conventional low-frequency aural receiver to receive voice and unmodulated transmission. Information received via the direction finder set is presented visually on the No. 1 needle of the pilot and copilot/gunner BDH indicators, and aurally through the intercom system. The receiver is installed in the aft radio compartment. Electrical power to operate the set is supplied by the 26 volt ac essential bus through circuit breakers marked ADF RCVR and ADF IND from the 28 volt dc non-essential bus through a circuit breaker marked ADF RCVR.

ADF CONTROL PANEL.

The ADF control panel is marked ADF and is located in the pilot right console (figure 7-12). The panel incorporates the controls for the ADF receiver and associated loop antenna and sense antenna.

ADF Operating Procedure.

To operate the direction finder set in any particular mode, perform the following preliminary steps:

1. ADF RCVR, ICS PLT, INV MAIN dc circuit breakers — CLOSED.

2. ADF RCVR, ADF IND, GYRO CMPS, 28 vac circuit breakers — CLOSED.

3. ADF monitor — PULL OUT, ADJUST.

4. Mode selector — AS DESIRED.

5. Frequency — SELECT.

ADF OPERATION.

1. Mode selector — ADF.

2. BFO-OFF — OFF (Except for CW station).

3. Tuning meter — TUNE (for maximum deflection.)

4. GAIN control — ADJUST.

ANTENNA OPERATION.

In this mode the No. 1 pointer on the BDH indicator is inoperative. To operate the ADF set in the ANT mode perform the following:

1. Mode selector — ANT.

2. GAIN control — ADJUST.

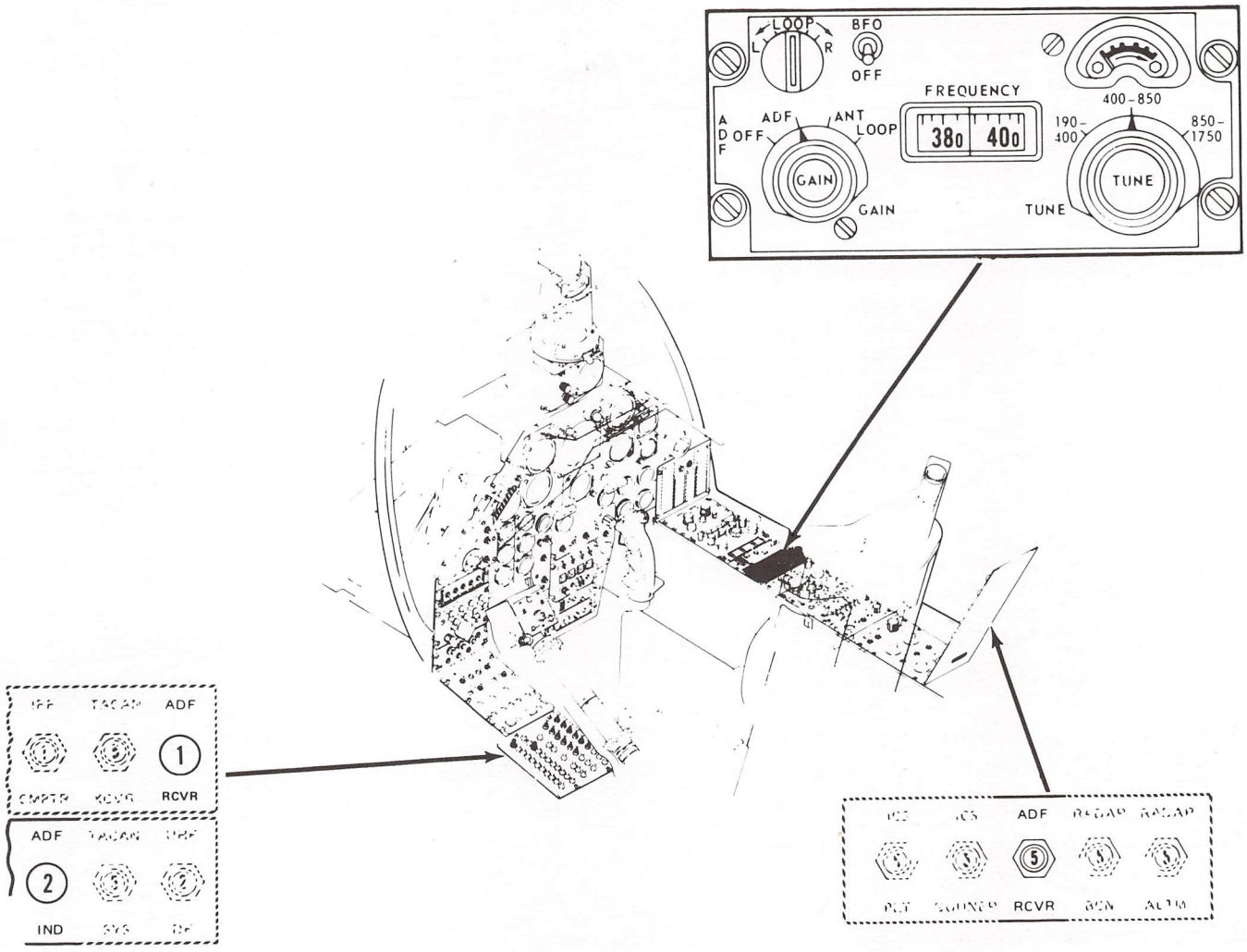
MANUAL LOOP OPERATION.

1. Mode selector — LOOP.

2. BFO-OFF — OFF (Except for CW station).

3. GAIN control — ADJUST.

4. LOOP — MOVE (left or right for null.)



NOMENCLATURE	FUNCTION	NOMENCLATURE	FUNCTION
Band selector switch	Selects desired frequency band.	BFO switch	Turns BFO on or off.
TUNE control	Selects the desired frequency.	Mode selector switch	ADF — Automatic direction finding station direction on No. 1 pointer in BDHI.
Tuning meter	Facilitates accurate tuning of the receiver.		ANT — Low frequency radio receiver using sense antenna only.
GAIN control	Controls receiver audio volume.		LOOP — Manual direction finding or aural null operation using loop antenna only.
LOOP L-R	Rotates loop antenna to the right or left when in loop mode.		

210900-145

Figure 7-12. Automatic Direction Finder (ADF)

SECTION VIII — WEAPONS SYSTEM

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NOTE

- In this section, the copilot/gunner will be referred to as gunner for brevity.
- Refer to figure 8-22 for acronyms used in this section.

INTRODUCTION.

The AH-1T (TOW) helicopter provides a high degree of armament carrying versatility through the utilization of six integral armament control systems: GTK4A/A Turret System, Navy Armament Control and Delivery System, Emergency Jettison System, Smoke Grenade Dispenser System, TOW Missile System and Helmet Sight Subsystem.

WARNING

- A single store may be flown within the 6-inch lateral CG limits. Stores on both store stations on the same side, with opposite side empty, can exceed the lateral CG limit for some loadings.
- Firing of TOW missile, 2.75-inch FFAR, and 20-mm gun in icing conditions is prohibited. The TOW missile warhead can detonate in close proximity to the helicopter. The warhead fuse can be damaged as missile is launched through ice in missile launcher. Gun barrels and breeches can rupture if gun muzzles are clogged with ice. FFAR can be held captive in the launcher tubes by the frozen ice.
- Helicopter control shall be maintained, especially at low altitude to prevent hazardous flight conditions and loss of TOW missile control. When gunner is tracking a TOW missile and pilot is using his helmet sight to fire the turret simultaneously, the pilot may have a strong tendency to lose contact with his instrument panel and outside references or develop target fixation.

ARMAMENT CONFIGURATION.

Refer to the AH-1 TACTICAL MANUAL, NAVAIR 01-110HC-1T, for all the authorized store loadings.

INTERRELATION OF ARMAMENT.

The armament subsystems are interfaced with one another. Figure 8-1 shows pilot and gunner control components in relationship to each armament subsystem.

ARMAMENT FIRING MODES.

Figure FO-8 shows switch positions for principal firing modes.

CONTROL COMPONENTS	TURRET	TOW MISSILE	WING STORES ROCKETS	WING STORES GUN POD	SMOKE GRENADE DISPENSER	TARGET ACQUIRE FOR TSU	WING STORES JETTISON
PILOT STATION:							
Armament Control Panel	X	X	X	X	X	X	
Store Control Panel			X	X			
Smoke Grenade Dispenser Control Panel					X		
Smoke Grenade Release Switch					X		
Wing Stores Jettison Button							X
Pilot Steering Indicator		X					
Gunner Accuracy Control Panel		Training					
Fixed Sight	X		X	X			
Helmet Sight	X					X	
Cyclic Switches	X		X	X			
Emergency Jettison Select Panel							X
GUNNER STATION:							
Cyclic Switches	X		X	X			
Helmet Sight	X					X	
Telescopic Sight Unit	X	X					
Left Hand Grip	X	X					
Armament Control Panel	X		X	X			
Wing Stores Jettison Switch							X
Sight Hand Control	X	X				X	
TOW Control Panel	X	X				X	

Figure 8-1. Interrelation of Armament

GTK4A/A TURRET SYSTEM.

The GTK4A/A Turret System provides for positioning, sighting ammunition feeding, and firing of the M197 20-mm automatic gun. The system consists of turret assembly, turret control assembly, pilot and gunner controls, pilot and gunner helmet sight, gunner TSU, airspeed pressure transducer, ammunition feed system with booster assembly, gun control assembly, gun drive assembly and a gun recoil adapter. If electrical power is removed from the Turret System for any reason, emergency 28 vdc power is applied directly to an auxiliary drive circuit in the turret assembly which automatically brings gun to upper stow position for safe landing. Upper stow position for gun is zero degrees azimuth, 11 to 14 degrees up elevation, and lower stow position is zero degrees azimuth and elevation. A pilot override mode is provided, which allows gunner emergency operation of the weapons system, less smoke and TOW.

Functions.

The turret assembly, which is chin-mounted on the helicopter (figure 8-2), provides mounting for the M197 20-mm automatic gun. Electrical circuits in the turret control assembly and turret assembly provide remote control for azimuth and elevation drive system in the turret. The azimuth drive system rotates the turret through a range of 110 degrees either side of zero degrees azimuth. Gun can be lowered 50 degrees below zero degrees elevation. The gun control assembly controls operation of gun and operation of the ammunition system. The gun control assembly also supplies firing voltage and supplies it to gun when gun drive power is applied. The gun drive assembly rotates gun barrels at a firing rate of approximately 650 rounds per minute. Power applied to the ammunition feed system operates booster assembly on ammunition box and energizes a declutching solenoid on gun feeder. The booster assembly and gun feeder provide a flow of ammunition from the ammunition box. The ammunition feed system contains 750 rounds of belted 20-mm ammunition. The gun is fired for duration of trigger command signal plus clearing cycle, or in limited 16 ± 4 round bursts. The first detent on the cyclic trigger fire switch/LHG trigger allows gun control assembly to automatically terminate each trigger command signal after 16 ± 4 rounds are fired. The second detent allows continuous firing.

CAUTION

The M197 automatic gun is restricted to a firing schedule not to exceed a 450 round burst with a minimum of 6 minutes cooling time prior to firing remaining 300 rounds.

The gun control assembly also terminates trigger command signal when gun reaches azimuth or elevation limits, and when gun position disagrees in azimuth or elevation more than 5.5 degrees from sight position command signal. Flow of ammunition to gun stops immediately upon termination of trigger command signal. Time delay circuits in gun control assembly continue gun drive power and firing voltage long enough for gun to fire ammunition remaining in gun unless trigger command signal is terminated by position error. Should trigger command signal be terminated by position error in excess of 5.5 degrees, firing voltage is terminated simultaneously; however, gun drive power is continued to clear live ammunition from gun.

The turret has five modes of operation. Pilot and gunner control utilizing the HSS are fully covered under HSS in this section. The TSU guns mode is fully covered under TMS in this section. The pilot or gunner may fire the turret in the fixed (Lower Stow) position utilizing the respective cyclic trigger fire switches when weapon control switch is in fixed or pilot override is selected.

The turret and wing stores cannot be fired simultaneously. Fixed forward mode: If the turret is firing and the WING ARM FIRE button is pressed, the clearing mode of the turret is actuated. Gunner-mode: If the turret is firing and the pilot TRIGGER ACTION switch is depressed, the clearing mode of the turret is activated and gun will stow. Rocket firing circuits are energized allowing pilot to fire rockets using WING ARM FIRE button.

WARNING

The turret may continue firing approximately 1/2 seconds after the WING ARM FIRE button and pilot TRIGGER ACTION switch have been released.

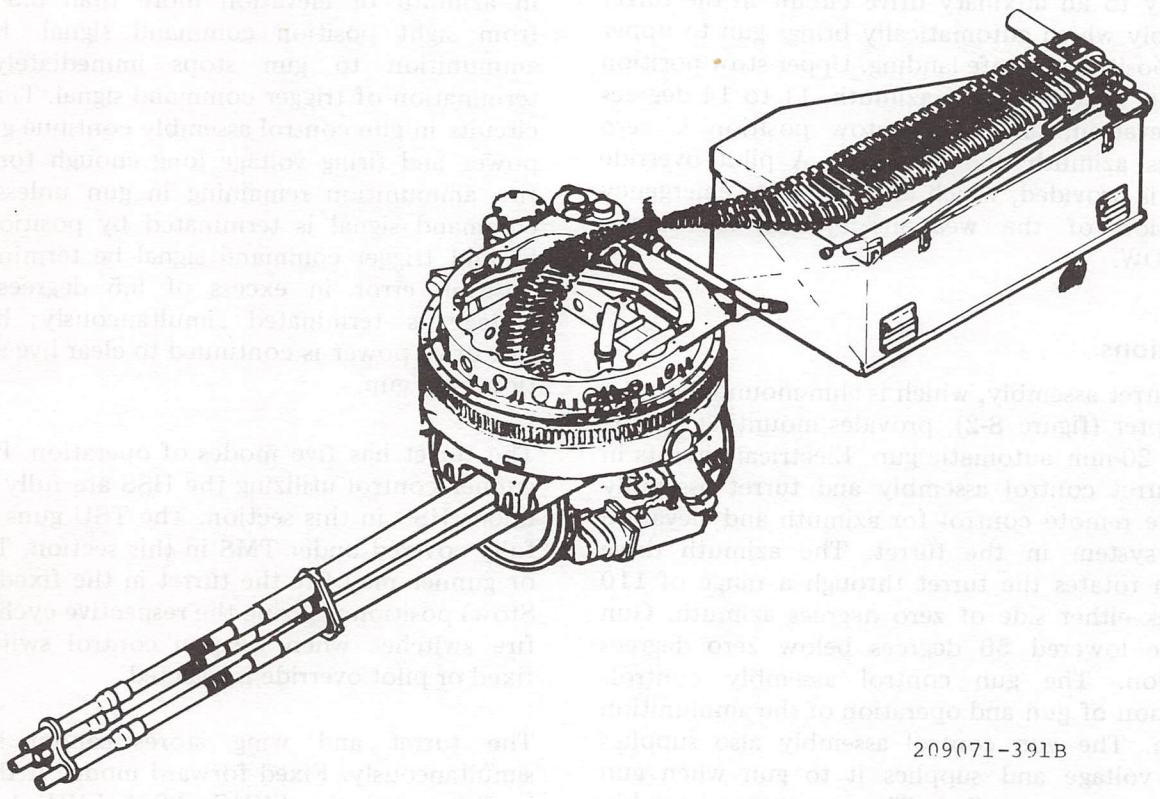


Figure 8-2. Turret

Pilot Mode.

If the turret is firing, pilot TRIGGER ACTION switch must be released in order to fire rockets. The pilot COMP switch provides recoil compensation inputs to tail rotor and cyclic through the SCAS. RANGE KNOBS on the pilot instrument panel and gunner armament control panel provide turret gun elevation inputs to compensate for range selected.

PILOT ARMAMENT CONTROLS AND INDICATORS.

Refer to figure 8-3.

Pilot Armament Control Panel.

The panel contains the controls and indicators to arm and fire armament subsystems and use the helmet sight subsystem. Refer to figure 8-4.

MASTER ARM SWITCH.

The MASTER ARM switch is a three position switch which permits the pilot to energize and deenergize the armament circuits. Placing the switch in ARM, arms the armament system. Placing the switch in STBY, energizes the control circuits for complete operation of weapons systems with the exception of the trigger fire circuits. Placing the switch in OFF, deenergizes the armament and control circuits.

Smoke grenades can be released, utilizing the smoke release button while master arm is in STBY or ARM.

WEAPON CONTROL SWITCH.

A three position WEAPON CONT switch is provided to allow the pilot to select the mode of operation of the armament system. In the gunner position, the gunner is primary armament system operator.

The weapon CONT switch must be in the gunner position to operate the TMS. However, the pilot can also select and fire wing stores utilizing the rocket lock-out (Pilots' Trigger Turret Action). If the gunner places the TCP mode select in any of the TOW functions, control of the turret reverts to the Pilots' Helmet sight (PHS). In the FIXED position, the pilot is in control of the turret and wing stores. This position is used in conjunction with the pilot fixed sight. In PILOT position, the pilot is the primary armament system operator, and has the capability to fire the turret with the HSS, and select and fire wing stores. For a depiction of armament firing modes, refer to FO-8.

Navy Armament Control and Delivery System (NARCADS).

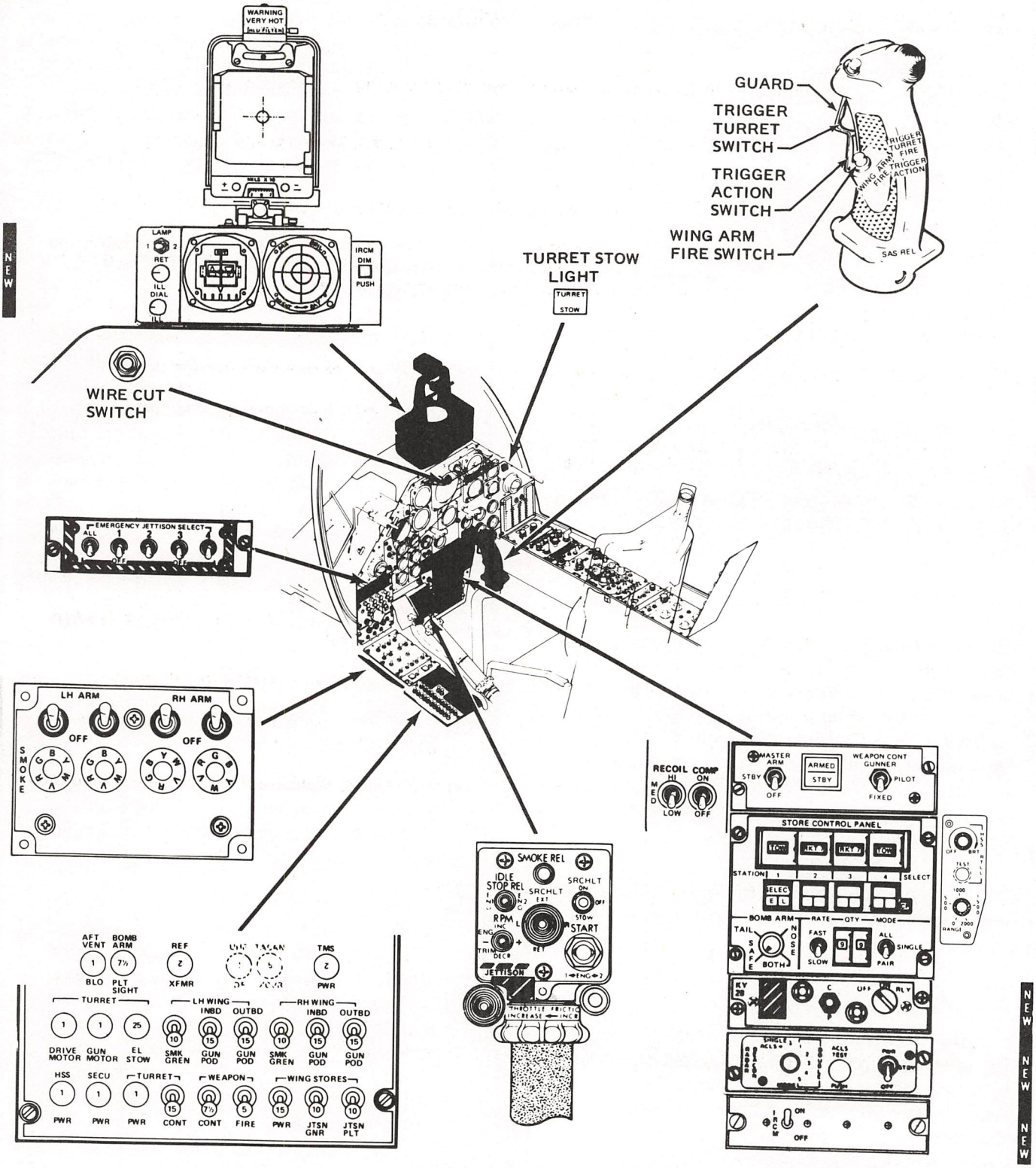
The NARCADS stores control panel (figure 8-5) enables the pilot to program the automatic release of weapons/stores from four wing stations in the quantity, mode, and rate selected; and the gunner to select, in PILOT OVERRIDE condition, inboard or outboard stations only. The system permits selective weapons/stores release by the pilot. It incorporates safety features which require matching the selected station and the selected type of weapons/stores registered for that station. NARCADS provides capability for inflight arming of droppable weapons.

NOTE

- Incorrect thumbwheel settings may allow weapons to fire.
- Identical weapons may be released/fired simultaneously from wing stations. There is no capability to fire dissimilar weapons simultaneously.
- By selecting a dissimilar store on the station select, the previously selected dissimilar store will automatically deselect. The pilot can select additional stations for the gunner. Example: If the gunner selects Pilot override, inboard, the pilot can additionally select stations 1 and/or 4. If the QTY counter shows 0/0 in SINGLE or PAIR mode, no weapons will fire.

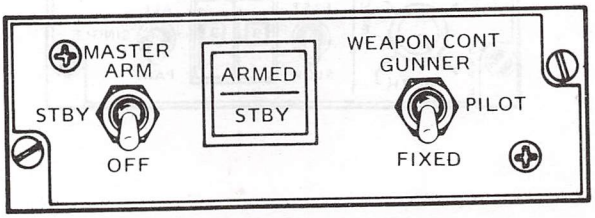
Pilot Fixed Sight.

Refer to figure 8-6.



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Figure 8-3. Pilot Controls and Indicators

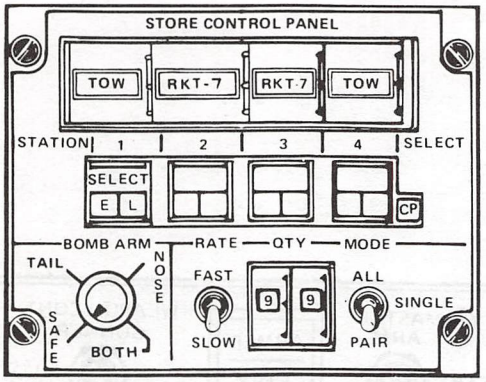


LOCATION: PILOT INSTRUMENT PANEL

NOMENCLATURE		FUNCTION
MASTER ARM Switch	OFF	– Deactivates all sights and weapon control/firing circuits.
	STBY	– Activates all sights, turret and TOW missile control circuits, and arms smoke grenade firing circuits. Charges wing gun pod battery. Illuminates pilot and gunner STBY lights.
	ARM	– Activates all sights and weapon control/firing circuits. Charges wing gun pod battery. Illuminates pilot and gunner ARMED lights.
WEAPON CONT Switch	FIXED	– Permits pilot to fire turret and wing stores (not TOW) using fixed sight.
	PILOT	– Permits pilot to fire turret using HS and wing stores (not TOW) using fixed sight.
	GUNNER	– Permits gunner to fire turret using HS or TSU and TOW using TSU. Illuminates GUNNER IN CONT light on gunner armament panel.
ARMED STBY Indicator	ARMED	– Indicates MASTER ARM switch in ARM (amber light) or gunner PILOT OVERRIDE switch is in OVERRIDE.
	STBY	– Indicates MASTER ARM switch in STBY (green light).
	Off	– Indicates MASTER ARM switch is off.
	Press	– Tests indicator lights.

210075-209

Figure 8-4. Pilot Armament Control Panel



NOMENCLATURE	FUNCTION
THUMBWHEEL REGISTRATION SWITCHES	NOTE Switches must be manually set to indicate weapons installed before weapons can be fired.

EMPTY	— Indicates no weapons (Off)
RKT 7	— 7-tube rocket launcher
RKT 19	— 19-tube rocket launcher
GUN PD	— GPU-2A
HTW	— Not used
FLARE	— Flare
TNG BB	— Training bomb
BOMBS	— Bomb
RKT 4	— 4-tube rocket launcher
DISP	— SUU-44 dispenser
(blank)	— Not used
TOW	— Indicator only for TOW rack

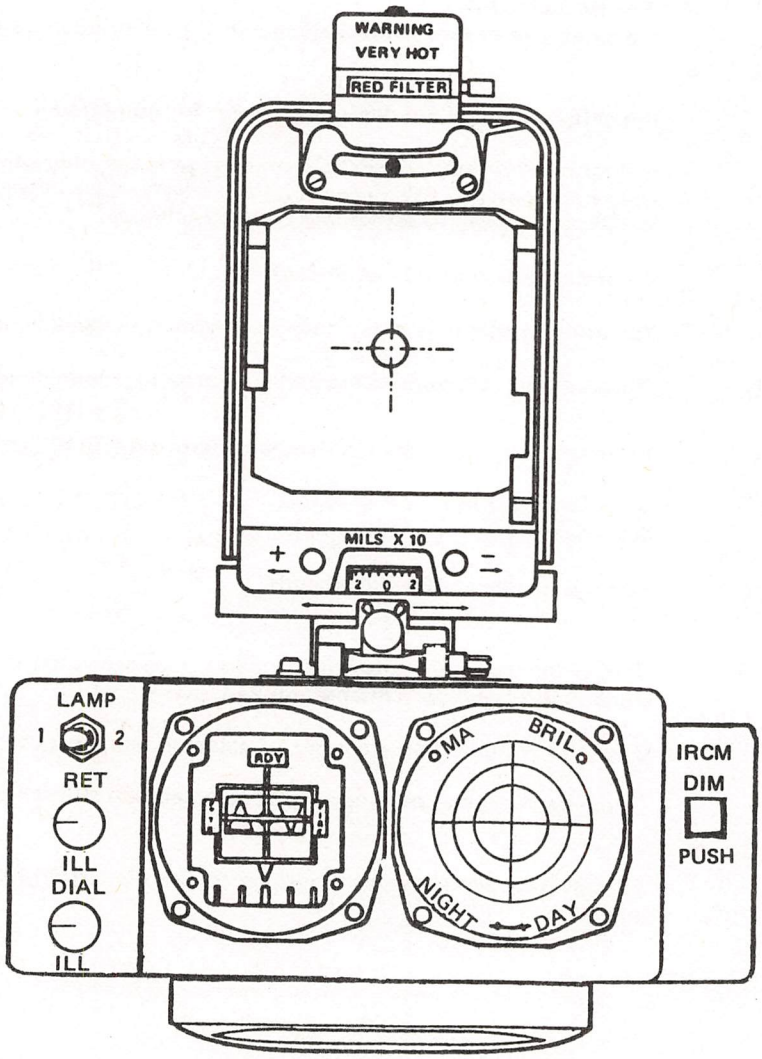
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Figure 8-5. Pilot Store Control Panel (Sheet 1 of 2)

NOMENCLATURE		FUNCTION
STATION SELECT	SELECT	— Indicates wing station is selected for firing and weapons are present.
	L	— (For Rockets Only) Indicates five or less rockets remain in 7-tube or 19-tube launcher.
	E	— Indicates weapons are depleted, except for gun pod and TOW.
CP	CP	— Indicates that PILOT OVERRIDE mode is selected and gunner controls turret and wing stores except TOW. Previous station selections are deselected. RATE, QTY, MODE, and thumb wheel settings remain applicable.
BOMB ARM	SAFE	— All arming solenoids de-energized.
	TAIL	— Tail arming solenoids energized. Nose arming solenoids de-energized.
	NOSE	— Nose arming solenoids energized. Tail arming solenoids de-energized.
	BOTH	— Both nose and tail arming solenoids energized.
RATE,	FAST	— (For Rockets Only) Sets release rate at 90 milliseconds.
	SLOW	— Sets release rate at 180 milliseconds.
QTY THUMBWHEELS/ INDICATOR		— Selects and displays number of fire pulses to be generated in the SINGLE or PAIR mode. (This function is disabled on ALL mode).
MODE	SINGLE	— Opposite wing station weapons of selected like stores to fire alternately.
	PAIR	— Opposite wing station weapons of selected like stores to fire concurrently.
	ALL	— All selected wing station weapons to fire concurrently. QTY select function disabled.

210071-31-2

Figure 8-5. Pilot Store Control Panel (Sheet 2 of 2)



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Figure 8-6. Pilot Sight

Pilot Armament Circuit Breakers.

Refer to figure 8-7.

Smoke Grenade Dispenser Control Panel.

The SMOKE control panel is located on the pilot's left bulkhead (figure 8-8). The color of smoke grenades in each rack is set on a color indicating dial located below the ARM switch for each rack. To select grenades of a desired color, the pilot actuates the ARM switch directly above the color indicating dial set to the desired color. Pressing the SMOKE REL button on the pilot collective switch box, drops one grenade from each of four racks selected, and initiates a 400-cycle audio tone in the pilot's headset. The pilot hears the same audio tone regardless of how many grenades he is firing simultaneously and the tone is heard as long as the SMOKE REL button remains depressed. When the last grenade from the rack had been fired, the tone continues until the ARM switch for the particular rack is placed OFF.

GUNNER ARMAMENT CONTROLS AND INDICATORS.

Refer to figure 8-9.

Gunner Armament Control Panel.

The panel (figure 8-10), located on the gunner's right console, contains controls and indicators which enable the gunner to operate and monitor armament subsystems. The gunner can take armament command, regardless of pilot MASTER ARM switch position, through the use of the PILOT OVERRIDE switch. The gunner can then fire the turret and wing stores (not TOW and SMOKE) by use of his cyclic stick armament switches.

PILOT OVERRIDE SWITCH.

The PILOT OVERRIDE switch is located on the gunner armament control panel (figure 8-10). When in OVERRIDE, the switch electrically bypasses the MASTER ARM switch on the pilot armament control panel. All pilot store control panel switch positions remain valid. The CP light on the pilot store control panel illuminates, GUNNER IN CONT light illuminates, pilot and gunner ARMED lights illuminate and TCP status annunciator displays OFF. Armament systems are armed and controlled by the gunner, with the exception of TOW and smoke grenade release. The TSU is disabled during PILOT OVERRIDE operation; however, the turret can be controlled by the HS. The gunner can then fire the turret by depressing both cyclic TRIGGERS. Wing stores can be released or fired by placing gunner armament control panel WING STORES SELECT switch in INBD or OUTBD and depressing cyclic WING ARM FIRE button. When gunner places WING STORES SELECT switch to INBD, stations 2 and 3 are selected; when placed to OUTBD stations, 1 and 4 are selected. Placing the switch to OFF deselects all previously selected stations. OFF position of PILOT OVERRIDE switch allows normal control and operation of armament systems.

WARNING

- When in PILOT OVERRIDE, the armament system is armed and may be fired regardless of position of MASTER ARM switch.

- The gunner, while in pilot override, may fire dissimilar stores if dissimilar stores are loaded on opposite inboard or outboard stations.

NOTE

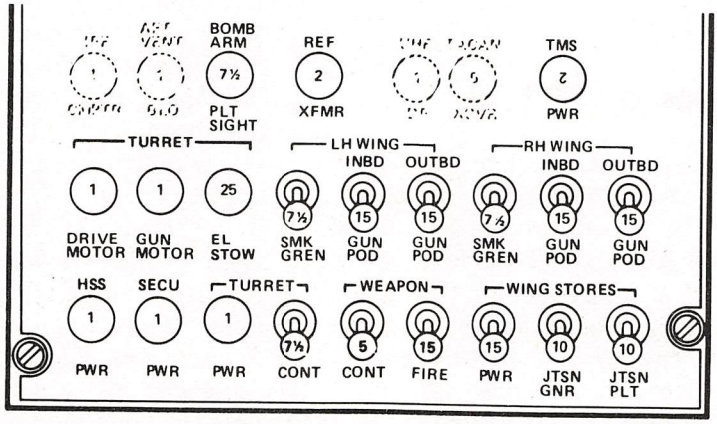
Pilot can disable all armament circuits by deenergizing the appropriate circuit breakers.

CYCLIC STICK ARMAMENT SWITCHES.

The pilot and gunner cyclic stick provides three armament switches, WING ARM FIRE, TRIGGER TURRET FIRE and TRIGGER ACTION.

Wing Arm Fire.

The WING ARM FIRE button on the cyclic stick is used to fire wing stores. After selecting wing stores, wing stores may be fired. An interrupter circuit, interrupts turret firing depending on mode of operation, i.e., fixed, gunner, or pilot.



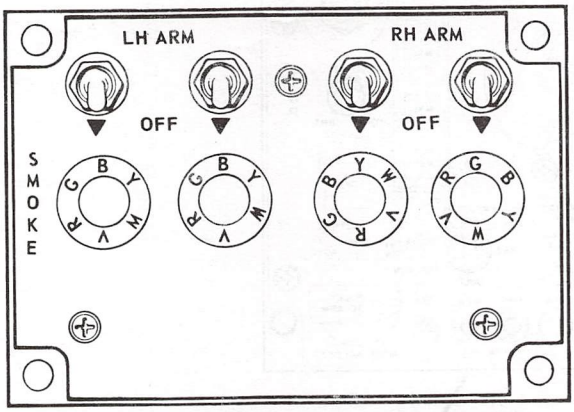
AC/ARMAMENT CIRCUIT BREAKER PANEL

LOCATION: PILOT LEFT CONSOLE

CIRCUIT BREAKER	FUNCTION - APPLIES POWER TO AND PROTECTS CIRCUIT FOR
BOMB ARM/PLT SIGHT	Bomb arming and pilot sight reticle.
REF/XFMR	Reference power for weapon system.
TMS/PWR	TOW missile firing.
TURRET	
DRIVE MOTOR	Turret control.
GUN MOTOR	Weapon rotation
EL STOW	Turret stow.
LH WING	
SMK GREN	Left hand smoke grenade dispenser.
INBD/GUN POD	Left hand inboard gun pod battery charging.
OUTBD/GUN POD	Left hand outboard gun pod battery charging.
RH WING	
SMK GREN	Right hand smoke grenade dispenser.
INBD/GUN POD	Right hand inboard gun pod battery charging.
OUTBD/GUN POD	Right hand outboard gun pod battery charging.
HSS/PWR	Helmet sight subsystem.
SECU/PWR	Servo electronic control unit.
TURRET	
PWR	AC turret control.
CONT	DC turret control
WEAPON	
CONT	Weapon control.
FIRE	Weapon firing.
WING STORES	
PWR	Weapons firing less smoke.
JTSN/GNR	Gunner jettison.
JTSN/PLT	Pilot jettison.

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Figure 8-7. Pilot Armament Circuit Breakers



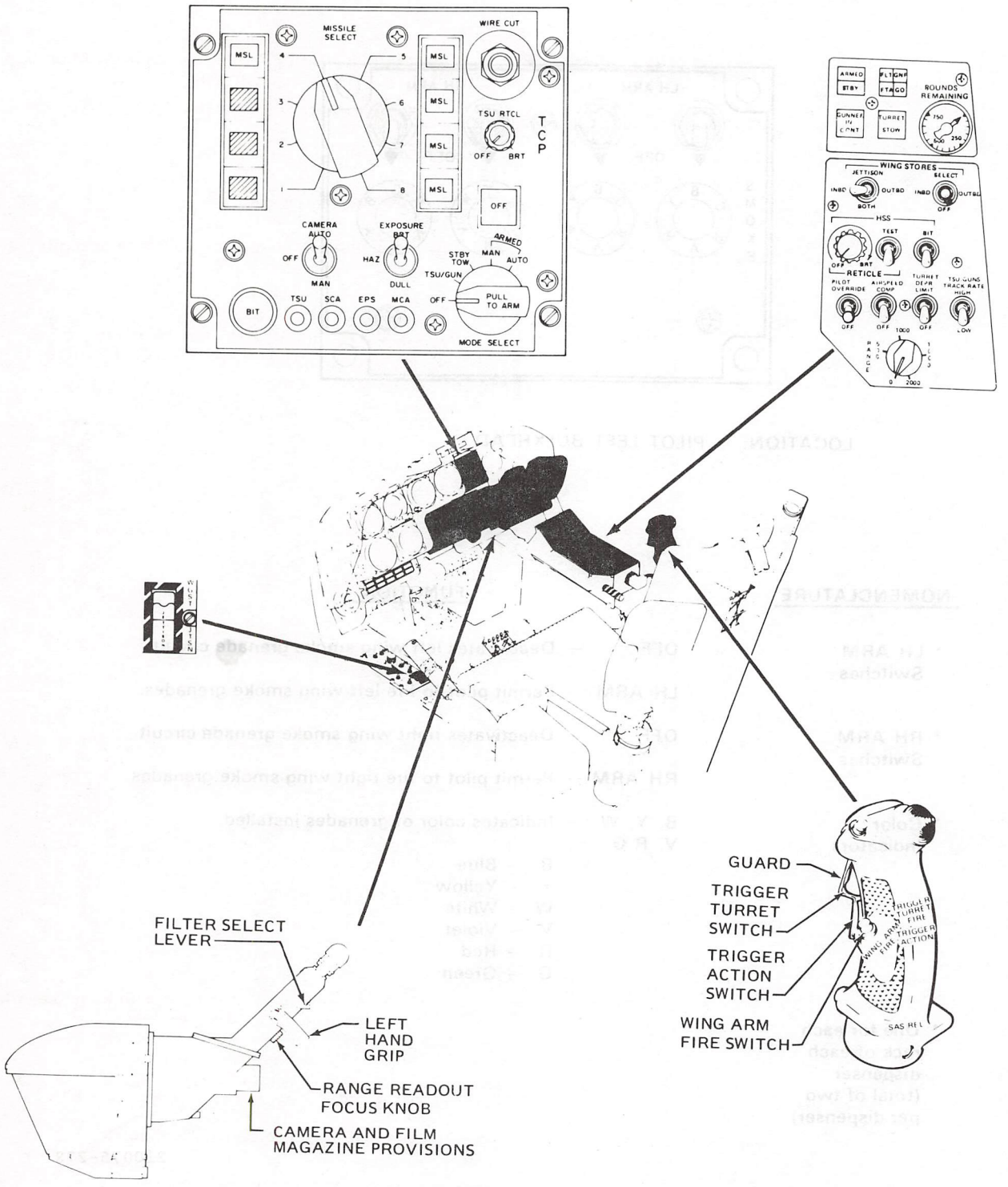
LOCATION: PILOT LEFT BULKHEAD

NOMENCLATURE	FUNCTION
* LH ARM Switches	OFF — Deactivates left wing smoke grenade circuit.
	LH ARM — Permit pilot to fire left wing smoke grenades.
* RH ARM Switches	OFF — Deactivates right wing smoke grenade circuit.
	RH ARM — Permit pilot to fire right wing smoke grenades.
* Color Indicators	B, Y, W, V, R,G — Indicates color of grenades installed. B — Blue Y — Yellow W — White V — Violet R — Red G — Green

* One for each rack of each dispenser (total of two per dispenser)

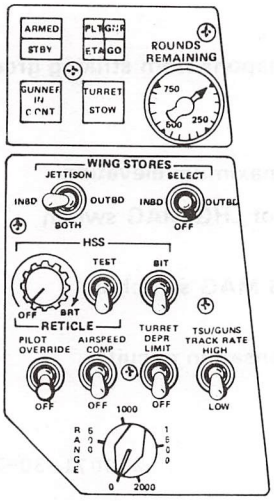
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Figure 8-8. Pilot Smoke Grenade Dispenser Control Panel



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Figure 8-9. Gunner Armament Controls and Indicators



NOMENCLATURE	FUNCTION
Indicators	
ARMED	— Indicates pilot MASTER ARM switch in ARM or PILOT OVERRIDE in OVERRIDE.
STBY	— Indicates pilot MASTER ARM switch in STBY.
PLT	— Indicates failure in pilot HS
GNR	— Indicates failure in gunner HS
EIA	— Indicates failure in electronic interface assembly
GO	— Indicates HSS operating properly
GUNNER IN CONT	— Indicates PILOT WEAPON CONT switch in GUNNER, or PILOT OVERRIDE in OVERRIDE.
TURRET STOW	— Indicates turret in upper stow position.

NOMENCLATURE	FUNCTION	
ROUNDS REMAINING indicator	Displays number of rounds remaining for the turret weapon.	
JETTISON switch	INBD	— Selects inboard stores to be jettisoned.
	BOTH	— Selects all stores to be jettisoned.
	OUTBD	— Selects outboard stores to be jettisoned.
SELECT switch	INBD	— Selects inboard stores to be fired.
	OFF	— Deactivates gunner wing arm fire switch.
	OUTBD	— Selects outboard stores to be fired.
HSS RETICLE switches	OFF-BRT	— Adjusts light intensity of gunner HS reticle.
	TEST	— Tests gunner HS reticle lamps (3).
HSS BIT	BIT	— Tests HSS interface assembly and pilot and gunner linkage assembly when both linkage arms are attached to BIT magnet.
PILOT OVERRIDE switch	OVERRIDE	— Overrides pilot MASTER ARM switch. Permits gunner to fire turret using HS and wing stores without sight (Not TOW or smoke).
	OFF	— Permits pilot armament control panel to control weapons
AIRSPEED COMP switch	COMP	— Applies airspeed data to turret positioning circuits.
	OFF	— Removes airspeed data from turret positioning circuits.

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Figure 8-10. Gunner Armament Control Panel (Sheet 1 of 2)

NOMENCLATURE		FUNCTION
TURRET DEPR LIMIT switch	TURRET DEPR LIMIT	— Limits downward travel to prevent turret weapons from striking ground.
	OFF	— Permits turret travel between minimum to maximum elevation.
TSU/GUNS TRACK RATE switch	HIGH	— Provides fast slew rates for TSU regardless of LHG MAG switch position.
	LOW	— Provides slow slew rates for TSU when LHG MAG switch in LO position.
RANGE switch	0-2000	— Provides meters — to — target data to compensation circuit.

210071-30-2

Figure 8-10. Gunner Armament Control Panel (Sheet 2 of 2)

Trigger Turret Fire.

The TRIGGER TURRET FIRE switch on the cyclic stick is used to fire the turret. After presetting switches on the pilot or gunner armament control panels, the turret may be fired. The TRIGGER ACTION switch on the cyclic stick must be depressed prior to depressing the TRIGGER TURRET FIRE switch. The gunner cyclic switches are energized only when his PILOT OVERRIDE switch is in the OVERRIDE position. A hinged guard prevents TRIGGER TURRET FIRE and TRIGGER ACTION switches from being inadvertently depressed.

Trigger Action.

The TRIGGER ACTION switch on the cyclic stick is used to slave turret movement to helmet sight movement. A hinged guard prevents TRIGGER ACTION and TRIGGER TURRET FIRE switches from being inadvertently depressed. When gunner is firing turret by use of LHG trigger, the pilot can interrupt by depressing pilot TRIGGER ACTION switch, placing WEAPON CONT switch on PILOT, or FIXED, or placing MASTER ARM switch to STBY or OFF.

HELMET SIGHT SUBSYSTEM (HSS).

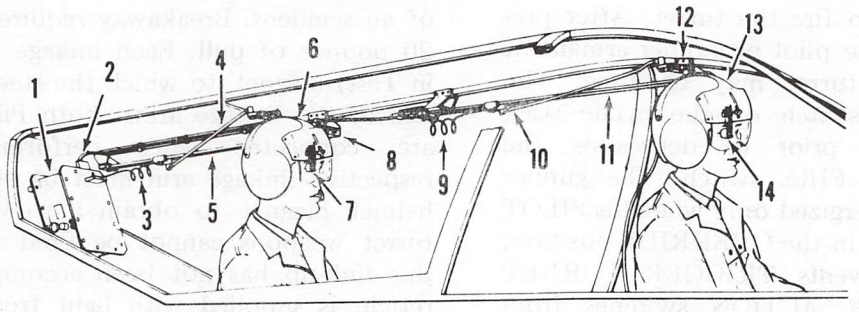
The HSS (figure 8-11) permits pilot or gunner to rapidly acquire visible targets and to direct turret on to those targets.

The HSS also provides a means of cueing from pilot to gunner for target location.

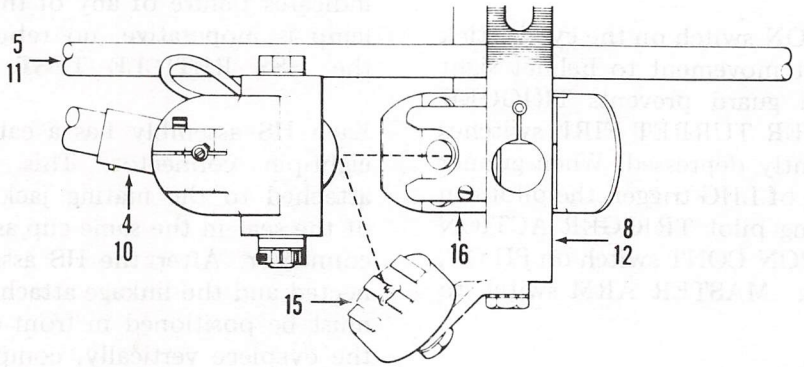
The HSS consists of two helmet sight (HS) assemblies mounted on the pilot and gunner helmets; two linkage assemblies mounted on the cockpit left canopy frame; and an electronic interface assembly mounted on the rear cockpit bulkhead.

Aiming of TURRET is accomplished by superimposing the reticle image on the target while depressing the appropriate TRIGGER ACTION switch. Error signals will cause the turret to move until aligned with the viewer's sight line. The reticle image is projected by a reflex sight in front of the operator's right eye, and appears as a yellow/white pattern focused at the target range. Each linkage assembly (Pilot and Gunner) is stowed by sliding the respective linkage arm into a spring loaded stow bracket at the forward end of the linkage. In operation, the linkage arm is connected to the pilot and gunner's helmet by means of a magnet at the rear of the helmet. This attachment is for quick breakaway in the event of an accident. Breakaway requires approximately 20 pounds of pull. Each linkage has a BIT (Built in Test) magnet, to which the steel fastener at the end of the linkage arms (both Pilot and Gunner) are connected when performing BIT. The respective linkage arm must be connected to the helmet magnet to obtain a viewing reticle. The turret weapons cannot be fired with the HS, if this link-up has not been accomplished. The HS reticle is supplied with light from one of three lamps. Three lamps are provided to ensure reliability through redundancy. After linkage arm link-up with the helmet, the HS reticle test switch indicates failure of any of the three lamps. If one lamp is inoperative, no reticle will appear when the HSS RETICLE TEST switch is activated.

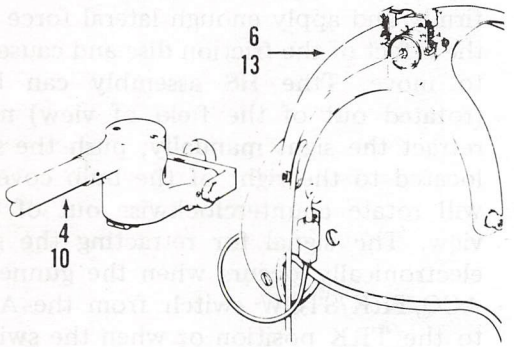
Each HS assembly has a cable terminating in an eight-pin connector. This connector must be attached to the mating jack located on the side of the seat in the same clip as the communications connector. After the HS assembly has been connected and the linkage attached, the sight eyepiece must be positioned in front of the eye. To adjust the eyepiece vertically, compress the ends of the spring lock with the left hand and move the eyepiece up or down with the right hand. To adjust the sight laterally, grasp the sight housing firmly and apply enough lateral force to overcome the effect of the friction disc and cause the housing to move. Tthe HS assembly can be retracted (rotated out of the field of view) manually. To retract the sight manually, push the small button located to the right of the bulb cover. The sight will rotate counterclockwise out of the field of view. The signal for retracting the gunner sight electronically occurs when the gunner moves the ACQ/TRK/STOW switch from the ACQ position to the TRK position or when the switch is in the TRK position and the PHS ACQ switch is depressed. The signal moves the sight out of the way automatically before the gunner looks into the TSU. The sight, once retracted, must be manually returned to the field of view by rotating the sight counterclockwise until it latches in front of the eye. The turret is positioned in azimuth and elevation by moving the HS with the linkage attached, while the appropriate switch is depressed; vertical movement of the head will produce elevation movement of the turret and horizontal movement of the head will produce azimuth movement of the turret. If the HSS assembly is on the retracted position, positioning and firing circuits



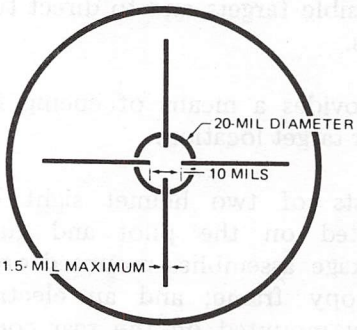
HELMET SIGHT SUBSYSTEM



PILOT/GUNNER LINKAGE ARM ATTACHMENT TO BIT MAGNET AND STOW BRACKET



PILOT/GUNNER LINKAGE ARM ATTACHMENT TO HELMET SIGHT



PILOT/GUNNER EYEPIECE RETICLE PATTERN

1. Electronic Interface Assembly
2. Gunner Extension Cable
3. Pilot Linkage Cable
4. Pilot Linkage Arm
5. Pilot Linkage Rails
6. Pilot Helmet Sight
7. Pilot Eyepiece
8. Pilot Linkage Front Support
9. Gunner Linkage Cable
10. Gunner Linkage Arm
11. Gunner Linkage Rails
12. Gunner Linkage Front Support
13. Gunner Helmet Sight
14. Gunner Eyepiece
15. BIT Magnet
16. Stow Bracket

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Figure 8-11. Helmet Sight Subsystem (HSS)

are not interrupted. Release of the action switch will cause the turret to return to the stow position regardless of HS position. If the action switch is depressed and the sight is moved at a speed greater than the maximum angular velocity of the turret, the firing circuit is interrupted and the sight reticle flashes until the gun is coincident within 5.5 degrees of the HS line of sight. The sight reticle also flashes when turret is moved to azimuth or elevation travel limits. HSS reticle OFF-BRT knobs and TEST switches are located on the pilot instrument panel and the gunner armament control panel. An HSS BIT switch on the gunner armament control panel tests the HSS, PLT (Pilot), GNR (Gunner) and EIA (Electronic Interface Assembly). Failure indicator lights plus a GO (HSS operating properly) indicator light are also located on the gunner armament control panel.

TOW MISSILE SYSTEM (TMS) AH-1T/M65.

The tube launched, optically tracked, wire guided (TOW) missile subsystem (TMS) is designed to launch and guide the TOW antitank missile from the AH-1T (TOW) Cobra. See figure 8-22 for (TOW) missile system acronyms.

Functional Elements.

The TMS launching and guiding capabilities are provided by five functional elements of hardware packaged in eight Weapon Replaceable Assemblies (WRAs), mounted within the aircraft. See figure 8-12 and FO-9.

The five functional elements are:

1. Stabilized sight.
2. Controls and displays.
3. Infrared.
4. Missile command.
5. Launcher.

The first element, the stabilized sight, provides the capability for sighting and tracking a target using commands generated by the gunner. This element consists of the Telescopic Sight Unit (TSU) and Stabilization Control Amplifier (SCA). An optical telescope within the TSU allows the gunner to look at a magnified image of the target for acquisition and tracking. The TSU optics are stabilized to effectively isolate the gunner's field of vision from the helicopter vibration and rotational motion.

The second element, controls and displays provide: positioning commands to the TSU, system turn-on, missile selection, steering direction for the pilot, system status to the gunner and pilot, self test commands, and operational mode selections. This element consists of the Sight Hand Control (SHC), TOW Control Panel (TCP), Pilot Steering Indicator (PSI), Status Annunciators and a Left Hand Grip (LHG).

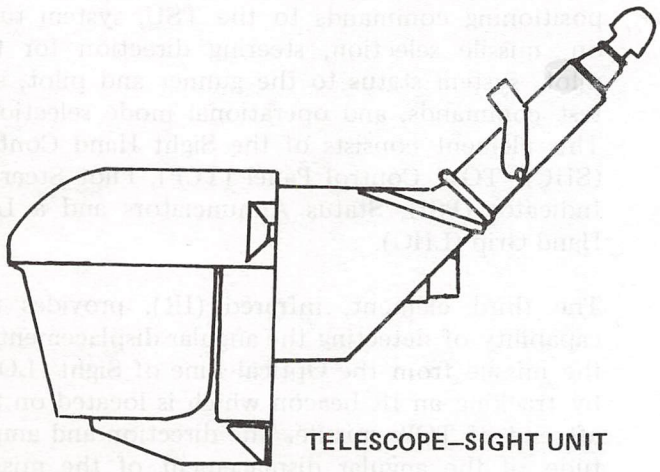
The third element, infrared (IR), provides the capability of detecting the angular displacement of the missile from the Optical Line of Sight (LOS), by tracking an IR beacon which is located on the aft end of TOW missile. The direction and amplitude of the angular displacement of the missile from the TSU LOS is used to generate missile position error signals. This element is located in the TSU and consists of the IR tracker and error detector.

The fourth element, missile command, processes the missile position error signals that are generated by the IR element into FM multiplexed signals. These signals are transmitted over the missile command wires as commands which are used to direct the missile back to the TSU optical LOS. This element consists of the Missile Control Amplifier (MCA).

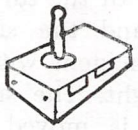
The fifth element, launcher, consists of the TOW Missile Launcher (TML) attached to the outboard wing stations (figure 8-13). The launchers are designed so that either two or four missiles can be loaded on each wing station. The interrelationship of the five elements is graphically illustrated in figure FO-9.

Built In Test.

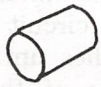
The TMS has an automatic BIT, consisting of ten distinct tests designed to verify system operational integrity and to indicate a failure of one of four WRAs (TSU, SCA, MCA, and EPS). The EPS is the only WRA in the sytem which maintains a continuous operating integrity check and will give a positive indication of malfunction any time the TMS is receiving power. BIT is initiated whenever the TMS is initially powered, and is immediately sequenced, automatically to each test. When the TMS is armed, BIT is interrupted and the system is immediately ready for use. BIT cannot be performed if ACQ/TRK/STOW switch is in any



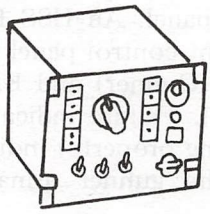
TELESCOPE–SIGHT UNIT



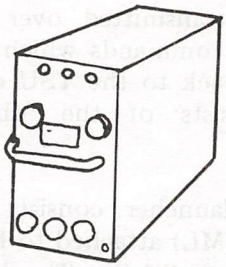
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HAND CONTROL



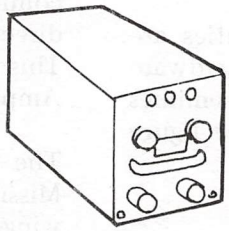
PILOT
STEERING
INDICATOR



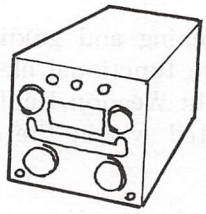
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PANEL



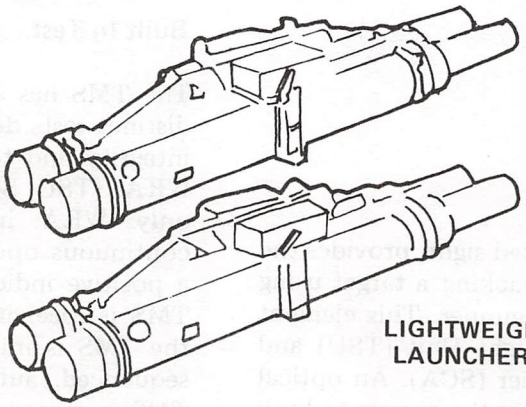
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CONTROL
AMPLIFIER



MISSILE COMMAND
AMPLIFIER



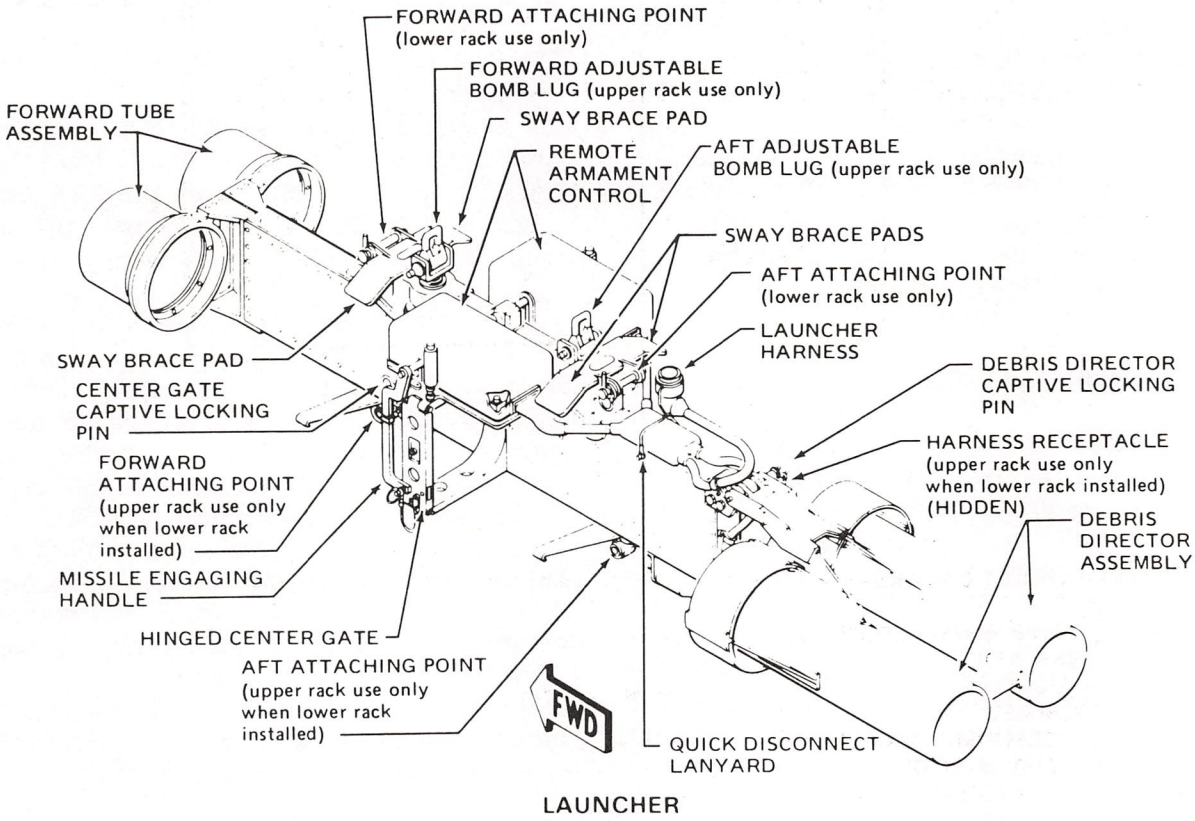
ELECTRONIC
POWER
SUPPLY



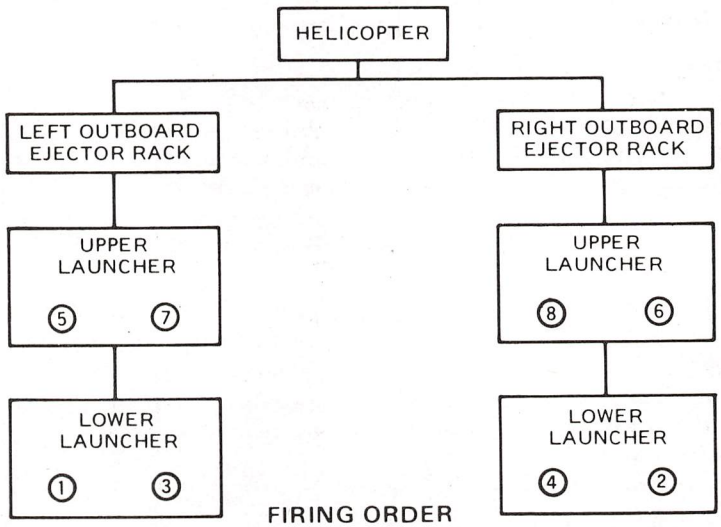
LIGHTWEIGHT
LAUNCHERS

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Figure 8-12. Weapons Replaceable Assemblies



LAUNCHER



FIRING ORDER

(LOOKING FORWARD)

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Figure 8-13. TOW Missile Launcher

position other than STOW. An indication appears on the TOW control panel (TCP) that shows whether BIT is In-Test (Test), pass (Power On) or fail (OFF). If the system fails BIT, an indicator will appear to isolate the failure to one of the previously mentioned four WRAs. The BIT equipment reset switch on the TOP resets the BIT fail indicators and recycles BIT sequence. The following units are not checked via BIT: TCP, SHC, PSI and Launchers. When the manual BIT button on the TCP is depressed, all annunciators in the TSU and PSI will be displayed. When the BIT button is released, the annunciators will disappear from view and the BIT checks are initiated.

Telescopic Sight Unit (TSU).

The TSU (figure 8-14) is one of the WRAs which makes up the TMS. This WRA contains the optical system necessary for firing the TOW missile. Visually the TSU has an angular coverage of plus and minus 110 degrees in azimuth and +30 to -60 degrees in elevation. The TSU is mounted on the nose of the helicopter and extends into the front cockpit. The SHC is mounted on the right side of the TSU and the LHG is mounted on the left. The IR tracker and error detector are located in front of the TSU.

In operation, the IR tracker and error detector receives IR energy from the missile during flight and senses any missile displacement from the optical LOS. This information is used to generate the command signals which direct the missile back to the LOS. During system self test, the IR tracker is automatically boresighted to the optical LOS. The stabilization system isolates the optical system from helicopter motion.

NEW The optical fields of view offer a 28-degree field of view in the 2x magnification, and a 4.6-degree field of view in a 13x magnification. The gunner's left hand grip (LHG) is mounted on the TSU relay tube in a location that optimizes the gunner's ability to grasp it for support and at the same time operate necessary controls. The LHG controls are used to select 2x or 13x magnification, provide a trigger switch for firing the TOW missile, and provide a weapon action switch for initiation of the attack mode. Annunciators within the TSU provide the gunner with system status information. Mounted on the bottom of the TSU relay tube is a focus knob which will compensate for any astigmatism. The eyepiece is monocular and can be rotated so that either eye can be used to view through the optics.

Stabilization Electronic Control Amplifier (SCA).

The SCA is one of the WRAs making up the TMS. It contains circuitry used to control power input to the Electronic Power Supply (EPS). SCA motion compensation circuitry has inputs from the SHC track stick and TSU and provides azimuth/elevation LOS drive output for the TSU. A servo loop controls the TSU optics window and derotation error inputs. The servo loop generates window and derotation servo drive signals to position the TSU optics. The azimuth/elevation error signals from the TSU and SCA drive signals are used to generate pitch and yaw error signals and LOS rates for the Missile Control Amplifier (MCA). The yaw open loop command is generated from gimbal resolvers and air speeds. The SCA contains a constraints computer which determines whether launch conditions are within pre-determined boundaries. If the helicopter is within pre-determined boundaries, the constraints computer provides a contraints valid signal to the MCA. Stabilization circuits, error signal resolution, motion compensation and open loop missile steering are also provided by the SCA.

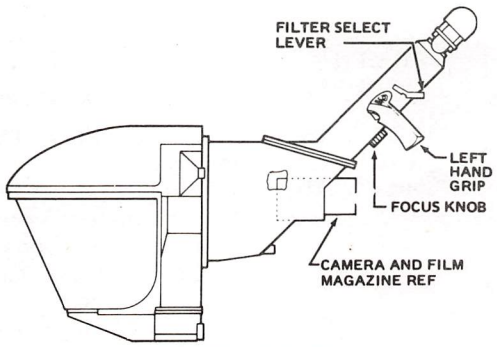
TOW Control Panel (TCP).

The TCP is the WRA which provides gunner controls and indicators for TOW missile selection, missile status, BIT, manual wire cut and camera controls, if camera is installed. When the BIT is depressed, ten sequential BITs are performed automatically. The TCP receives a missile status signal from the TML and displays missile status: present (MSL), selected (SEL), missile not present (BARBER POLE).

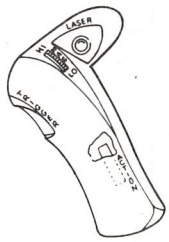
The TOW missiles can be selected manually (Mode select: ARMED MANUAL or automatically (Mode select: ARMED AUTO). If AUTO is selected, the missile select switch will automatically sequence to the first missile present by numbered priority one through eight. If MAN is selected, each missile must be selected manually. See figure 8-15.

Missile Command Electronic Control Amplifier (MCA).

This WRA provides system timing, processes missile guidance and command signals, and provides automatic control of BIT.

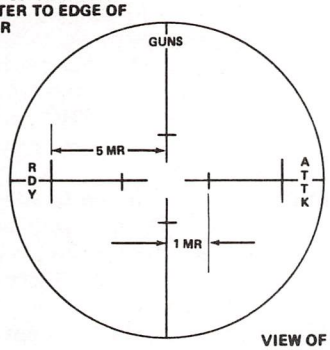


TELESCOPIC SIGHT UNIT
LOCATION: GUNNER STATION



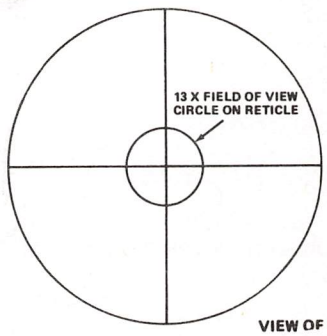
LEFT HAND GRIP

13 X RETICLE FIELD OF VIEW IS 4.6° FROM RETICLE CENTER TO EDGE OF CROSSHAIRS – 0.2 MR



VIEW OF HI MAG RETICLE
NOT TO SCALE

2 X RETICLE FIELD OF VIEW IS 28°



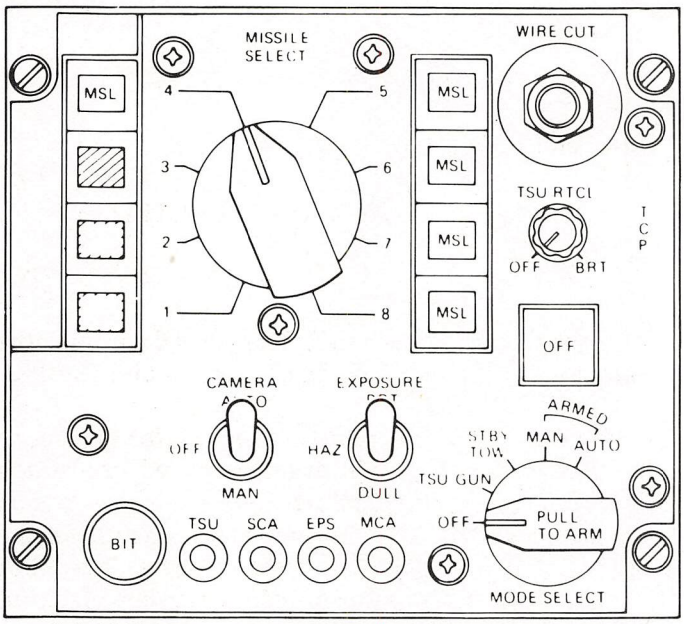
VIEW OF LO MAG RETICLE
NOT TO SCALE

NEW

NOMENCLATURE		FUNCTION
Left Hand Grip Switches		
MAG Switch	LO	— Magnifies target two times.
	HI	— Magnifies target 13 times.
TRIGGER Switch	Press	— Fires TOW in first or second detent.
		— Fires turret 16 ± 4 round burst in first detent.
		— Fires turret continuously in second detent.
ACTION Switch	Press	— Activates TOW launchers.
		— Slaves turret to TSU or gunner HS.
LASER Switch		— Inoperative.
TSU Reticle		
GUNS Indicator	Flash	— Indicates TCP MODE SELECT switch in TSU/GUN and turret not aligned with TSU.
	Steady	— Indicates TCP MODE SELECT switch in TSU/GUN and turret aligned with TSU.
ATTK Indicator	ON	— Indicates TCP MODE SELECT switch in ARMED and ACTION switch depressed.
RDY Indicator	ON	— Indicates pilot has achieved prelaunch constraints for TOW firing.
Filter Select Lever	Move	— Selects filters of different light intensities.
Focus Knob	Turn	— Focus the target image.

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Figure 8-14. Gunner Telescopic Sight Unit (TSU)



LOCATION: GUNNER INSTRUMENT PANEL

NOMENCLATURE		FUNCTION
MODE SELECT Switch	OFF	— Deactivates TSU and TMS circuits.
	TSU/GUN	— Permits gunner to fire turret and perform target acquisition, pilot to fire smoke/wing stores (not TOW) and perform target acquisition. Activates built-in-test (BIT) when SHC switch is in STOW, power missile status indicators.
	STBY TOW	— Permits gunner to control TMS/perform target acquisition, pilot to fire turret and perform target acquisition. Activates built-in-test (BIT) when SHC switch is in STOW, power missile status indicators.
	ARMED MAN	— Permits gunner to fire TOW (manually selected) and perform target acquisition, pilot to fire turret, and perform target acquisition.
	ARMED AUTO	— Same as MAN except missile is automatically selected.

NOMENCLATURE		FUNCTION
TSU/SCA/EPS/MCA Unit Fail Indicators	Black Flag	— Indicates unit operation during performance of built-in-test.
	White Flag	— Indicates unit failure after performance of built-in-test.
	Note	— Only EPS indicates failure at any time power is supplied to the TMS.
BIT Switch	Press	— Performs manual built-in-test.
CAMERA Switch	OFF	— Deactivates camera circuit.
	MAN	— Permits continuous operation of camera.
	AUTO	— Permits operation of camera when LHG TRIGGER is pressed until missile command wire is cut.
EXPOSURE Switch	BRT	— Permits camera to adapt to bright conditions.
	HAZ	— Permits camera to adapt to haze conditions.
	DUL	— Permits camera to adapt to dull conditions.
OFF/PWR ON/ ARMED/TEST System Status Annunciator	OFF	— Indicates MODE SELECT switch in OFF position.
	PWR ON	— Indicates MODE SELECT switch in TSU/GUN or STBY TOW position and BIT is complete.
	ARMED	— Indicates MODE SELECT switch in ARMED position.
	TEST	— Indicates built-in-test is being performed.
TSU RTCL Switch	OFF	— Deactivates the TSU reticle lamp.
	Turn	— Varies intensity of TSU reticle lights.
WIRE CUT Switch	PRESS	— Permits gunner to manually cut missile command wire.
MSL/Barberpole Missile Status Indicators	MSL	— Indicates missile is present in a specific location of launcher.
	Barberpole	— Indicates missile is not present in a specific location of launcher.
MISSILE SELECT Switch	1/2/3/4/5/6/7/8	— Indicates missile selected (manual or automatic) for firing.

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Figure 8-15. Gunner TOW Control Panel (TCP)

MCA circuitry, provides automatic control of BIT and BIT status signals to the TCP. TOW trigger armed signal is used to start the MCA programmer timer. The programmer provides a timing signal in proper sequence for 23 seconds from initiation of fire signal to automatic wire cut. The launch constraints valid signal from the SCA or a constraints override signal from the SHC is required before the trigger in the LHG can initiate the fire sequence. The open loop command from the SCA is processed by the MCA and aids in controlling the missile yaw during the interval between launch and acquisition by the IR tracker. The MCA utilizes pitch and yaw error signals, LOS rates and G-bias signals to generate wire signals A and B which are transmitted through the TML to the missile. The MCA G-bias networks provide a G-bias signal used to compensate for gravity on the missile during missile flight. During interval between initiation of fire sequence and launch (1.5 seconds), self balance circuitry causes MCA and missile frequencies to be aligned. A carrier network generates signals to pitch and yaw channels providing a duty cycle for the missile for its entire flight.

Sight Hand Control (SHC) (Figure 8-16).

This WRA, mounted on the right side of the TSU in the gunner's station, contains the track stick which is a force transducer device. It provides the track commands which positions the TSU optics to enable target locating and tracking. SHC controls also select different modes of operation for the TSU. The constraints override button allows the gunner to initiate the TOW fire sequence if the aircraft is not within constraints valid limitation. (This function is normally only used by maintenance personnel. Probability of missile capture is greatly reduced utilizing constraints override).

Electronic Power Supply (EPS).

This WRA located in the tail boom, switches and conditions aircraft power, provides power forms not available from prime aircraft power sources, and converts 28 vdc to provide regulated and unregulated DC and AC voltage to operate the TMS.

The EPS is energized by remote-on command from the TCP. At system turn-on, BIT is performed automatically. The EPS supplies its own BIT signals and is the only WRA which maintains a continuous BIT during operation. If during operation, it fails, it will display the fail indication on the TCP. A thermal switch, located in the SCA, will activate if temperature limitations are exceeded, causing the EPS to shut down, thereby disabling the TMS.

TOW Missile Launcher (TML).

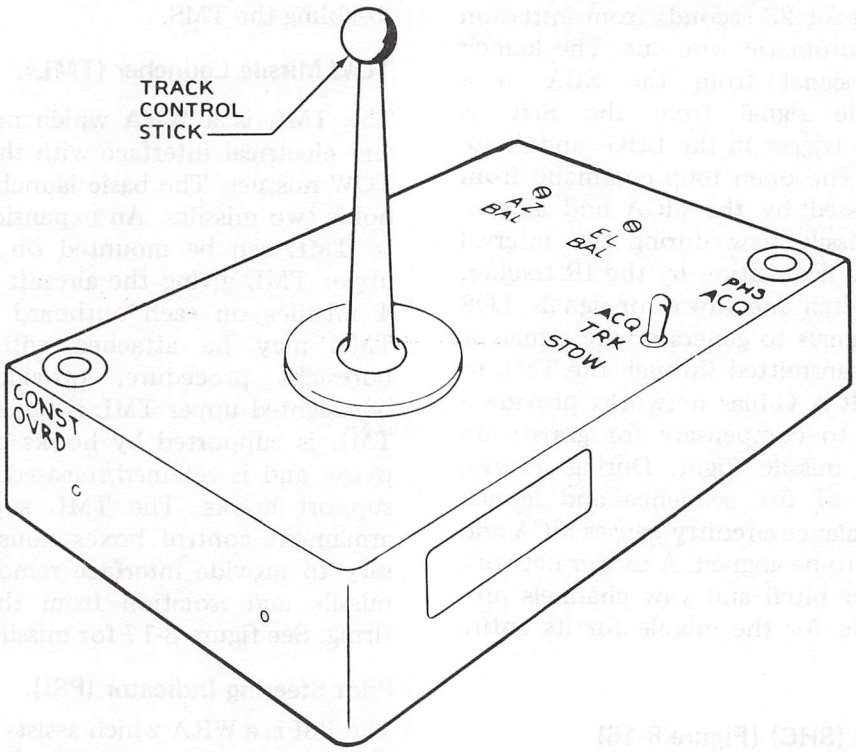
The TML is a WRA which provides the support and electrical interface with the M-65 for up to 8 TOW missiles. The basic launcher (see figure 8-17) holds two missiles. An expansion module identical to TML can be mounted on the bottom of the upper TML giving the aircraft the ability to carry 4 missiles on each outboard station. The lower TML may be attached without repeating the boresight procedure, provided the previously boresighted upper TML is not removed. The upper TML is supported by hooks beneath the aircraft pylon and is retained/released by rotation of the support hooks. The TML supports two remote armament control boxes housing circuitry necessary to provide interface remote control to fire a missile and isolation from the system prior to firing. See figure 8-17 for missile location.

Pilot Steering Indicator (PSI).

The PSI is a WRA which assists the pilot in aligning the aircraft within pre-launch constraints ($\pm 2.5^{o}$ AZ, $\pm 6^{o}$ EL, 5° angle of bank) in preparation for missile firing and for maneuvering after firing (± 110 AZ, $+60^{o}$ to -30° EL, 30° angle of bank). Two pointer type ascend/descend indicators will indicate the direction to correct for excessive pitch rates. See figure 8-18. The PSI has three status annunciators. The ATTK annunciator tells the pilot that all conditions are met for a TOW launch except when the aircraft is not aligned in pre-launch constraints. When the RDY annunciator appears, all conditions are met for a TOW missile launch and the fire sequence can be initiated by the gunner with the LHG fire trigger. When the gunner initiates the fire sequence, the FIRE annunciator appears for the duration of missile flight or until wire cut. The ATTK and RDY annunciators will disappear from view at launch. The only indication of aircraft attitude not depicted by the PSI is angle of bank. However, if the PSI indicates all aircraft alignment conditions have been met and a RDY annunciator is not visible, then the aircraft is probably out of pre-launch roll constraints ($\pm 5^{o}$).

TOW Missile System Function.

(See inflight procedures all armament for switchology.)



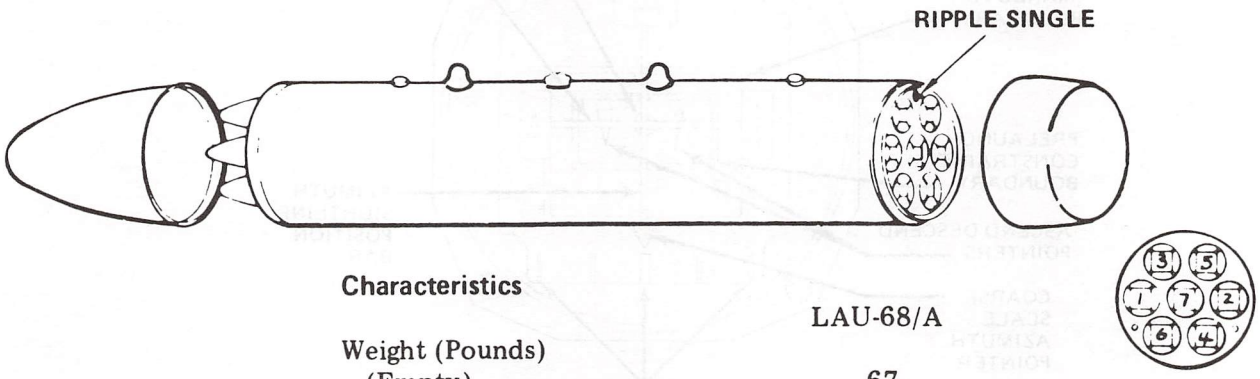
LOCATION: GUNNER INSTRUMENT PANEL

NOMENCLATURE		FUNCTION
Track Control Stick	Move	— Positions TSU in aximuth and elevation.
ACQ/TRK/STOW Switch	ACQ	— Slaves TSU to gunner HS for target acquisition.
	TRK	— Permits track control stick to position TSU.
	STOW	— Stows TSU dead-ahead.
PHS ACQ Switch	Press	— Slaves TSU to pilot HS for target acquisition.
EL BAL Screw		— Used during maintenance.
AZ BAL Screw		— Used during maintenance.
CONST OVRD Switch	Press	— Permits TOW firing when helicopter is not aligned within the prelaunch constraint boundary. (Normally used only for maintenance)

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Figure 8-16. Gunner Sight Hand Control (SHC)

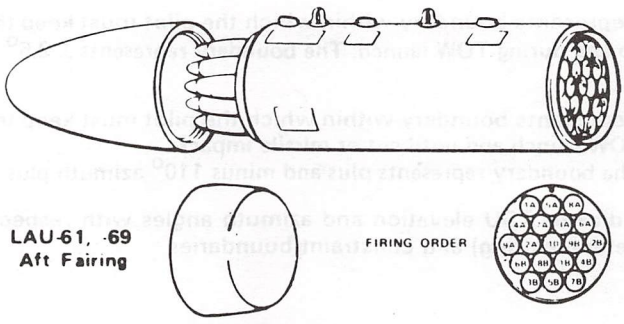
LAU-68 Rocket Launcher



Characteristics

	LAU-68/A
Weight (Pounds)	
(Empty)	67
(Loaded)	218
Length (Inches)	71
Diameter (Inches)	10
Suspension (Inches)	14

LAU-61, -69 Rocket Launchers



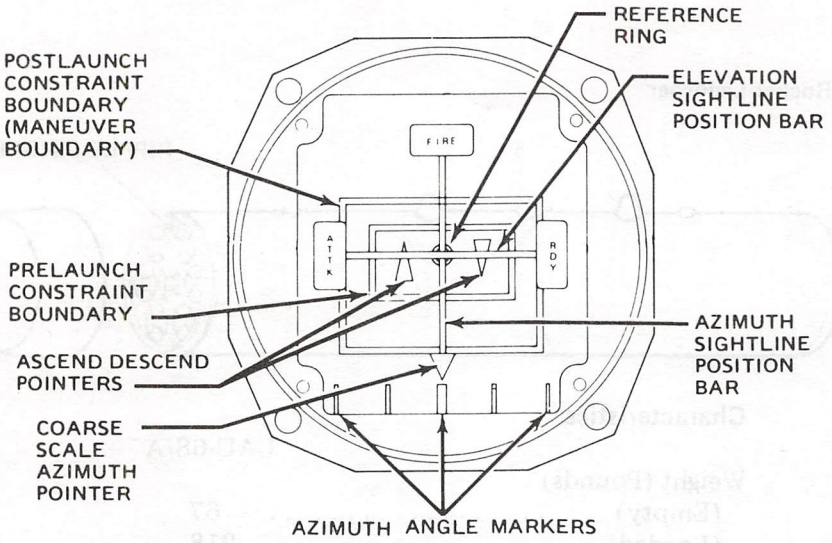
Characteristics

	LAU-61/A	LAU-69/A
Weight (Pounds)		
(Empty)	132	98
(Loaded)*	474	440
Length (Inches)	83.0	83.0
Diameter (Inches)	15.7	15.7
Suspension (Inches)	14.0	14.0

*Mk 5 Warhead

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Figure 8-17. LAU Series Rocket Launcher (Typical)



LOCATION: BASE OF PILOT FIXED SIGHT

NOMENCLATURE		FUNCTION
ATTK Annunciator	ON	— Indicates TCP MODE SELECT switch in ARMED position and TSU LHG ACTION switch depressed.
RDY Annunciator	ON	— Indicates pilot has achieved prelaunch constraints.
FIRE Annunciator	ON	— Indicates trigger has been pulled.
Reference Ring (Fixed)		— Represents helicopter reference axis.
Prelaunch Constraint Boundary (Fixed)		— Represents boundary within which the pilot must keep the sightline position bars prior to and during TOW launch. The boundary represents $\pm 2.5^{o}$ azimuth and $\pm 6^{o}$ elevation.
Postlaunch Constraint Boundary (Fixed)		— Represents boundary within which the pilot must keep the sightline position bars after TOW launch and until cut or missile impact. The boundary represents plus and minus 110° azimuth plus 60° to -30° elevation.
Elevation/ Azimuth Sightline Position Bars (Moveable)		— Indicates TSU elevation and azimuth angles with respect to helicopter reference axis (reference ring) and constraint boundaries.
Ascend Descend Pointers (Indicator)	ON	— Indicates amount of change required in nose-up or nose-down attitude to meet prelaunch constraints.
	OFF	— Indicates helicopter nose attitude and line-of-sight rate are compatible.
*Azimuth Angle Markers (Fixed)		— Represents TSU $\pm$ 110° azimuth limits.
*Course Scale Azimuth Pointer (Moveable)		— Indicates TSU azimuth angle on the azimuth angle markers.

*Fixed scale and gain. Not affected by pre/post launch.

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Figure 8-18. Pilot Steering Indicator (PSI)

Target Acquisition.

The gunner has several methods of acquiring a target through the TSU. By placing the ACQ/TRK/STOW switch in the TRK position. The TSU may be directed towards the target utilizing the SHC stick. This method will take more time than other methods and will require the gunner to search with the TSU. As the field of view is restricted to 28 degrees in LO mag and 4.6 degrees in HI mag, some difficulty may be encountered. The quickest method is to utilize either the PHS or GHS to direct the TSU optics. If the pilot places the PHS reticle on a target, the gunner can direct the TSU to that target by placing the ACQ/TRK/STOW switch on the SHC to TRK and depressing the PHS ACQ button, also located on the SHC. When the PHS ACQ button is depressed, the GHS reticle automatically retracts enabling the gunner to view through the TSU. The TSU will continue to align with the pilot's LOS until the gunner releases the PHS ACQ button.

If the gunner desires to direct the TSU to a target using the GHS, he proceeds as follows:

1. Superimpose the GHS reticle on target.
2. Move the ACQ/TRK/STOW switch to ACQ.

The ACQ/TRK/STOW switch is spring loaded from ACQ to TRK so it will be necessary to hold it in the ACQ position. As long as the switch is held in the ACQ position, the TSU will continue to align itself with the GHS LOS. When the switch is released, it will spring back to the TRK position and the GHS sight will automatically retract. The gunner then views through the TSU to re-acquire the target. The acquisition functions will operate for any mode select position on the TCP except OFF.

TOW Missile Firing.

Once the gunner has acquired a target in the LO mag, he switches to the HI mag position on the LHG. The small circle in the LO mag reticle of the TSU represents the limits of the HI mag field of view. If the target appears in the small circle of the LO mag reticle, the target will appear within the HI mag field of view. When in HI mag, the gunner should keep the weapons action switch depressed to get motion compensation and to complete the attack logic necessary to launch the TOW missile.

Weapons action switch - DEPRESSED (motion compensation)

1. HI mag — SELECTED
2. ACQ/TRK/STOW switch — TRK
3. Missile — PRESENT and SELECTED
4. TCP Mode Select — ARMED MAN or AUTO.

With these conditions met, the ATTK annunciator will appear in the TSU field of view and the PSI.

The PSI gives the pilot steering information to align the aircraft within pre-determined pre-launch constraints. As the aircraft comes into pre-launch constraints, the RDY annunciator appears on the PSI and within the TSU field of view. The pilot should strive to give the gunner as stable a platform as possible for the actual firing.

With the ATTK and RDY annunciators present, the firing sequence can be initiated by the gunner utilizing the TRIGGER on the LHG. By pulling the LHG TRIGGER and initiating the fire sequence, a fire annunciator appears on the PSI and the ATTK and RDY annunciators will disappear from view at launch. No annunciators will be evident in the TSU. After initiation of the fire sequence, there will be a 1.5 second delay before the missile launch. The 1.5 second delay is necessary for the following:

1. Missile battery charge-up.
2. Missile gyro spin-up.
3. Missile guidance set self-balance.

1.5 seconds after initiation of the fire sequence, the launch motor ignites. The launch motor accelerates the missile to 225 FPS and the missile holdback pin is sheared allowing the missile to exit the launch container. The launch motor burns out before the missile exits the launch tube and the missile coasts approximately 7-12 meters before the flight motor ignites. At this point, the wing and flight surfaces have snapped out into position and the flight motor ignites accelerating the missile to just under Mach 1. When the flight motor ignites, the acceleration of the missile causes a G-sensing device to complete the missile arming. At this point, nose crush is all that is necessary to detonate the warhead. The flight motor quickly burns out and the missile coasts for the duration of

the flight. Ignition of the flight motor will cause target obscuration, due to smoke and gases, for a short period of time. As target obscuration occurs, the gunner should release his control inputs with the SHC and allow motion compensation to keep the STU crosshairs on the target. As obscuration decreases, if the crosshairs have drifted off the target, the gunner should make a smooth positive correction back to the target avoiding jerky SHC movement.

When the missile is fired, the gains on the PSI change to postlaunch constraints and the maneuver limits are now represented by the large boundaries on the PSI. The pilot should strive to minimize erratic aircraft movement to minimize gunner tracking error.

The gunner continues to track the target until missile impact or wire cut. Wire cut will be automatically initiated by missile impact or by timer 23 seconds after TRIGGER pull or if IR tracker loses the missile or source for more than .5 seconds. Manual wire cut can be initiated by either the gunner or pilot, at any time, utilizing the respective wire cut buttons (see FO-6 and FO-7).

WARNING

Because of the nature of the missile flight controls, when wire cut occurs the missile flight will be extremely erratic.

TSU GUNS.

With TSU guns selected on the TCP mode SELECT, the gunner has the ability to fire the 20-mm turret in the flex mode utilizing the stabilized optics of the TSU. The ACQ/TRK/STOW switch must be in the TRK position and the LHG controls are utilized for weapons action and fire. The LO mag position should be utilized for the first firing burst. If the impacts are within the small circle of LO mag reticle, then the impacts will appear in the HI mag field of view. If the impacts are out of the small LO mag circle but, in a vertical plane with it, then an adjustment on the RANGE knob on the gunner armament control panel may bring the impacts into the small circle. If the impacts are horizontally out of the small LO mag circle, range adjustments will not bring the impacts into the HI mag field of view and HI mag should not be selected. Depression of the weapons action bar aligns the gun barrels with the TSU LOS and in HI mag also gives motion compensation. The TSU/GUNS TRACK RATE switch on the gunner's armament control panel, gives the gunner the ability to select a HI or LO track rate for the TSU while in TSU/GUN.

WARNING

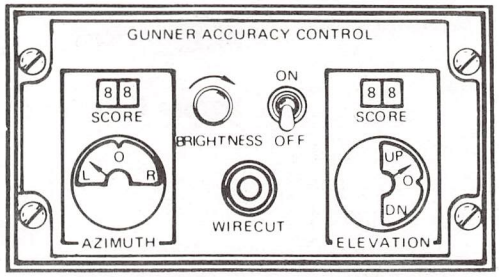
If the gunner fails to place the ACQ/TRK/STOW switch in STOW when coming out of the TSU and attempts to fire the GHS, the turret will fire in the direction of the TSU LOS.

Gunner Accuracy Control Panel (GACP).

The Gunner Accuracy Control Panel is a training device which allows the TMS to be operated under simulated conditions and is depicted in figure 8-19. A ground IR source is necessary (M-70) to utilize the GACP. The TMS must be armed for the GACP to function. After the system is armed and the GACP turned on, it will self test. The digital indicators will display 88, 99, and then return to 55±2 after 14 seconds. No calibration is necessary. The TSU must be receiving an IR signal from the M-70 before a firing sequence can be initiated. The TMS can be operated as though a missile were to be launched. The GACP provides a missile present indication and missile 5 must be selected. The missile present signal will disappear after the fire sequence has been initiated but will return after the scoring run has been completed. The azimuth and elevation meters provide a visual indication of tracking errors so the pilot can critique the gunner during the 12-second scoring run. It is not necessary to reset the GACP after the scoring run is completed. The PSI will display the FIRE indicator during the 12-second scoring sequence. The GACP panel will present a score for both azimuth and elevation after the scoring sequence is complete. The GACP is normally installed only for training purposes and is mounted on a bracket to the right side of the pilot's rocket sight.

WARNING

A TOW missile shall not be fired with GACP installed due to erratic missile response.



LOCATION: TOP OF PILOT INSTRUMENT PANEL IF INSTALLED

NOMENCLATURE	FUNCTION
ON/OFF Switch	ON — Activates gunner accuracy control circuits. — Performs built-in-test of circuits. Circuits pass test if AZIMUTH/ELEVATION SCORE indicators display 55 ±2. (TMS has to be ARMED.) OFF — Deactivates circuits.
WIRE CUT Switch	Press — Resets GACP and deactivates camera.
AZIMUTH Indicator	— Displays TSU azimuth line-of-sight deviation.
AZIMUTH SCORE Indicator	— Displays gunner final azimuth score.
ELEVATION Indicator	— Displays TSU elevation line-of-sight deviation.
ELEVATION SCORE Indicator	— Displays gunner final elevation score.
BRIGHTNESS Knob	Turn — Varies intensity of AZIMUTH/ELEVATION SCORE indicator lights.

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Figure 8-19. Pilot Gunner Accuracy Control Panel (GACP)

WING STORES JETTISON.

The pilot has an EMERGENCY JETTISON SELECT panel on the pilot instrument panel and a guarded JETTISON switch on the collective switch box (FO-6). The gunner has a WING STORES JETTISON switch on his armament control panel and a guarded JETTISON switch on the gunner miscellaneous panel (FO-7). Activation of a jettsion switch (pilot or gunner) fires the cartridges and separates the stores. Pilot jettison switch must be held depressed for at least one second to assure cartridge firing. Circuits are protected by the WING STORES JTSN PLT and WING STORES JTSN GNR circuit breakers on the pilot AC/Armament circuit breaker panel.

WING STORES ARMAMENT SYSTEM.

Four attachment points are provided, two under each wing. The pylon assemblies include external store racks, sway braces and standard electrical connections for external stores. The entire assembly is enclosed in a fairing that matches the lower contour of the wing.

The ejector rack of each pylon is equipped with an electrically operated ballistic jettison device. The jettison system consists of a breech block that utilizes cartridges with independent firing circuits.

ROCKETS.

The 2.75-inch folding fin aerial rocket (FFAR) subsystem is a light anti-personnel/assault weapon. A launcher (figure 8-17) can be mounted on each inboard and outboard ejector rack.

WING GUN POD (GPU-2A).

The self contained pod (figure 8-20) houses a 20-mm machine gun, electrical system, battery recharging system and has a capacity of 300 rounds of ammunition. The gun is capable of firing 750 rounds per minute.

SMOKE GRENADE DISPENSER (M-118).

A dispenser (figure 8-21) may be attached to each outboard ejector rack. Each dispenser contains two independently operated racks of six white or colored smoke grenades, 12 per dispenser. One to four grenades may be dropped at one time by the two dispensers.

NOTE

Interference by nuts and bolt fasteners on the body of the M-118 will prevent the sway brace bolt pads from complete seating on the dispenser.

PREFLIGHT PROCEDURES.

Before Exterior Check —All Armament — Preflight

WARNING

- Personnel should remain clear of gun and turret travel area when helicopter electrical circuits are energized.
- Personnel should remain clear of hazardous area of loaded weapons.
- Helicopters with loaded weapons should be pointed toward clear area.

1. MASTER ARM — OFF
2. PILOT OVERRIDE — OFF
3. ALE-39 ARM — SAFE
4. ALE-39 POWER — OFF.

NEW

Exterior Check — Preflight.

M 197 GUN SYSTEM.

1. Gun barrels — CHECK FREE ROTATION
2. Ammunition — VISIBLE IN FEEDER
3. Safing solenoid — DISCONNECTED
4. Elevation brake — ON (down position)
5. Turret fairing and access doors — INSTALLED AND SECURE.

WING STORES.

1. Wing ejector racks safety lever — LOCKED
2. Detent safety pins — INSTALLED
3. Check pods for security — SHAKE EACH END

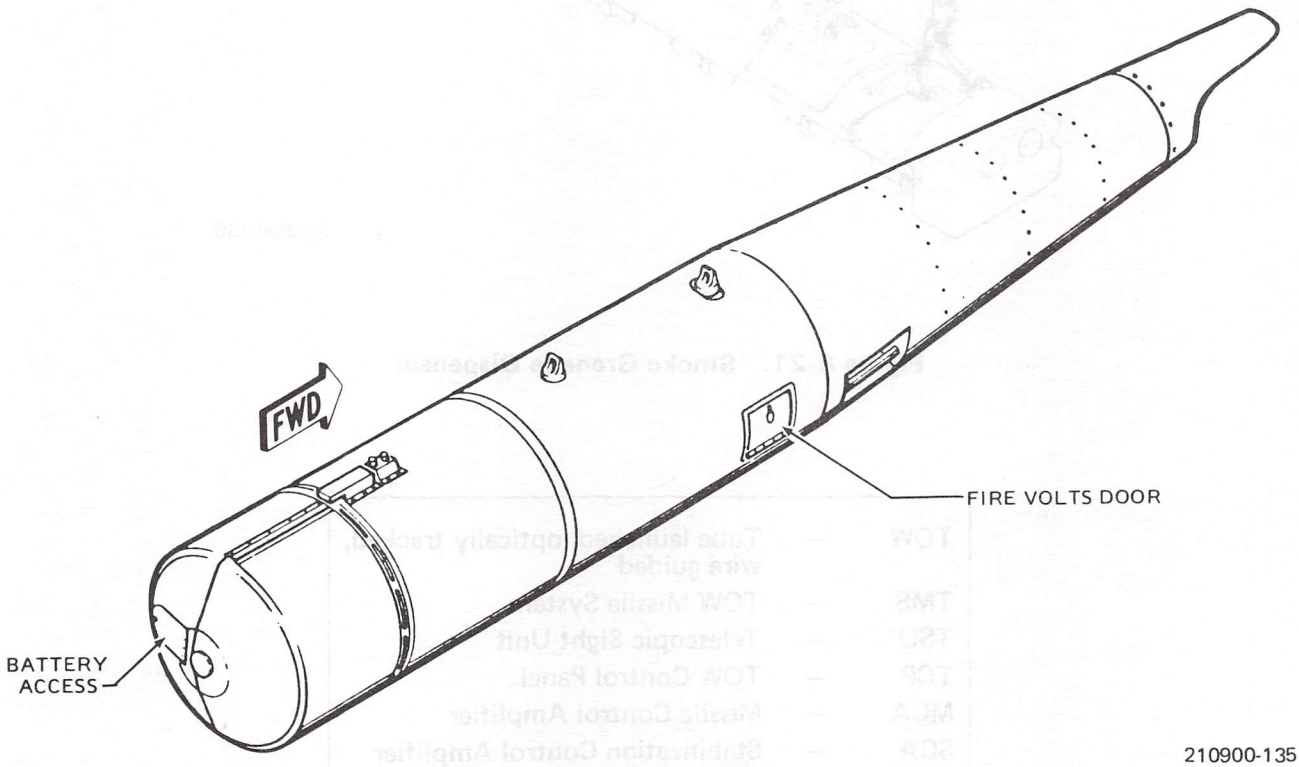
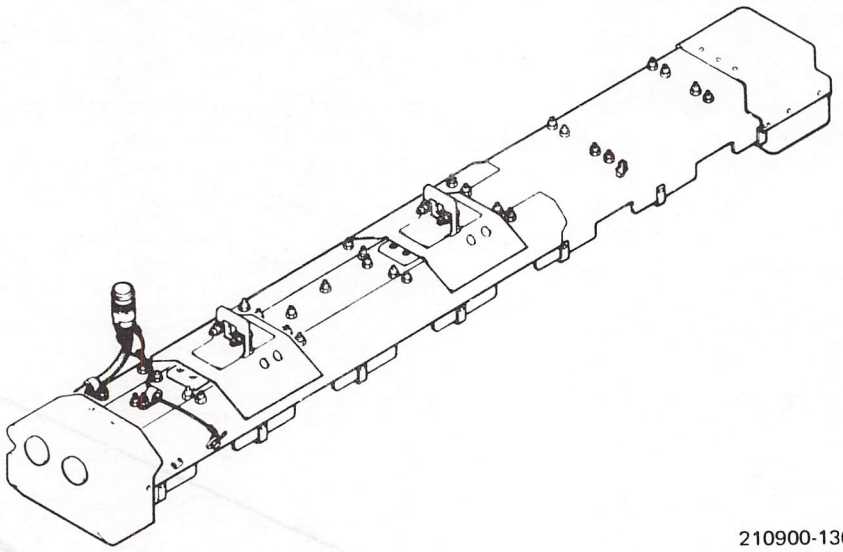


Figure 8-20. Wing Gun Pod (GPU-2A)



210900-136

Figure 8-21. Smoke Grenade Dispenser

TOW	—	Tube launched, optically tracked, wire guided
TMS	—	TOW Missile System
TSU	—	Telescopic Sight Unit
TCP	—	TOW Control Panel
MCA	—	Missile Control Amplifier
SCA	—	Stabilization Control Amplifier
SECU	—	SERVO Electronic Control Unit
EPS	—	Electronic Power Supply
SHC	—	Sight Hand Control
PSI	—	Pilot Steering Indicator
BIT	—	Built In TEST
WRA	—	Weapons Replaceable Assembly
TML	—	TOW Missile Launcher
EIA	—	Electronic Interface Assembly
LHG	—	Left Hand Grip
HSS	—	Helmet Sight Subsystem
PHS	—	Pilot Helmet Sight
GHS	—	Gunner Helmet Sight
LOS	—	Line-Of-Sight
IR	—	Infrared.

Figure 8-22. TOW Missile System Acronyms

4. Jettison cable — CONNECTED AND CARTRIDGE INSERTED
5. Rocket cable — DISCONNECTED FROM POD
6. Jettison feet — FLUSH WITH PODS.
7. ALE-39 DISPENSER POD SAFETY switches — SAFE.

NEW

MK 81/MK 82 BOMBS.

1. Fuze/fuze extension — HANDTIGHT, Arming delay — SET
2. Fuze arming assembly; arming vane and 2 Fahnestock clips — INSTALLED
3. Arming wires — NOT PRELOADED
4. Arming wire (M904E2/E3/E4) — PROPERLY ROUTED; 3 Fahnestock clips — INSTALLED
5. Single (Mk 9) arming wire (M1A1 Fuze Extension) — PROPERLY ROUTED; 3 Fahnestock clips — INSTALLED; Arming wire taped to fuze extension
6. Arming wires to rack arming solenoids — ATTACHED; Fahnestock clip — INSTALLED
7. Fuze and arming device/wires — REMOVED
8. Fin release wire — INSTALLED (if applicable); Safety pin — REMOVED
9. Overall condition — CHECK.

CBU-55 FUEL AIR EXPLOSIVE.

1. FMU-83/B fuze — INSPECT
   a. Fuze cover — REMOVED
   b. Fuze delay — SET
   c. Fuze safety pin — REMOVED
2. Tail fin thruster safety pin warning streamer — REMOVED
3. Arming wire extractor — CONNECTED
4. Fins — SPREAD/LOCKED
5. Leak detector — SAFE
6. Overall condition — CHECK.

MK 77 MOD 2/4 FIRE BOMBS.

1. Fire bomb — NO LEAK OR DAMAGE
2. Fuze (AN-M173A1/M918) — WRENCH TIGHT
3. Initiator (Mk 13) — INSPECT
   a. Retaining rings — TIGHT
   b. Tear-out section — NOT DAMAGED
   c. Functioning delay — SET
4. Arming wires/lanyards — NOT PRELOADED
5. Arming wire (AN-M173A1/M918) — ATTACHED
6. Arming wires/lanyards — ATTACHED
7. Fuze and arming wire device safety pins/wires — REMOVED (If applicable).

GPU-2/A GUN POD.

1. Helicopter adapter cables — DISCONNECT
2. Fire volts access doors — OPEN
3. Battery cable — DISCONNECTED
4. Drum — LOADED
5. Overall condition — CHECK.

FLARE DISPENSER.

SUU-44/A.

1. Detent safety pins — INSTALLED
2. Breech caps — HAND TIGHTENED
3. Spider cables — CONNECTED
4. Shear pins — INSTALLED FROM TOP, ENDS BENT
5. Dispenser — OVERALL CONDITION.

Section VIII

MK 45 FLARE.

1. Ejection dial — SAFE
2. Split ring — RED DISC INSTALLED
3. Swivel snap hook — NOT ATTACHED.

SMOKE GRENADE DISPENSER.

M118.

1. Electrical harness — CONNECTED
2. Grenade safety pin — IN PLACE
3. Grenade fuze — SECURE
4. Note color and position of installed grenades (needed for interior check).

ROCKET LAUNCHERS.

LAU 61/68/69.

1. RADHAZ shield — SECURE (if required)
2. RIPPLE/SINGLE MODE Selector switch — SINGLE
3. Select dial — ARM
4. Launcher — OVERALL CONDITION.

TOW.

1. Launcher Mounting — Upper launcher aft and forward adjustable bomb lugs secure to helicopter ejector racks and racks swaybrace bolts firmly against launcher swaybrace pads. Lower launcher aft and forward attaching points secure to upper launcher aft and forward attaching points.
2. Electrical connector — Upper launcher harness connected to helicopter receptacle and jettison quick disconnect lanyard attached to harness and launcher.

   Lower launcher harness connected to upper launcher harness receptacle.
3. Missile Installation — Missile container front ring seated in forward tube mating ring, hinged center gate and debris director secure with captive locking pins. Note number of and position of installed missiles (needed for interior check).

ARMING/DEARMING PROCEDURES — IN ARMING AREA.

1. Appropriate arming heading — ASSUME
2. Throttles — OPEN
3. Armament circuit breakers — DE-ENERGIZED
4. Smoke grenade switches — OFF
5. Emergency jettison select switches — OFF
6. Canopy jettison pins — IN
7. MASTER ARM — OFF
8. WEAPON CONT — FIXED
9. NARCADS store control panel —
   a. Bomb arm — SAFE
   b. QTY — 0/0
10. ALE-39
    a. ARM switch — SAFE
    b. PWR switch — OFF
11. Gunner armament control panel —
    a. PILOT OVERRIDE — OFF
    b. TURRET DEPR LIMIT — LIMIT
    c. WING STORES SELECT — OFF
12. TCP MODE SELECT — OFF
13. ACQ /TRK/STOW switch — STOW
14. RAD ALT — OFF
15. TACAN — RECEIVE
16. IFF — STBY
17. HANDS — IN VIEW OF ORDNANCE PERSONNEL.

NEW NEW

WARNING

No radio transmissions shall be made within 50 feet of arming or dearming aircraft.

AFTER ARMING

1. RAD ALT/TACAN — ON
2. IFF — AS REQUIRED
3. WEAPON CONTROL, HSS, JETTISON circuit breakers — ENERGIZED
4. Rounds remaining — SET
5. PHS and GHS rail arm assembly — ATTACH TO BIT MAGNET
6. MASTER ARM — STBY
7. Weapons control — GUNNER
8. HSS BIT — BIT/RELEASE (BIT will complete by 2.5 seconds)
9. PHS and GHS rail arm assembly — ATTACH TO HELMETS
10. PHS and GHS sight assembly — ADJUST
11. Pilot and gunner HSS test — TEST
12. TSU guns - TRACK RATE switch — HIGH
13. TCP MODE SELECT — STBY TOW

When TCP status indicator indicates test:

14. TCP BIT button — DEPRESS (verify all TSU/PSI indicators appear)
15. TCP BIT button — RELEASE

After BIT is complete, which can take up to 2 minutes:

16. TCP status indicator — INDICATES POWER ON
17. TCP BIT status indicators — INDICATE ON
18. Jettison select — AS REQUIRED
19. Take-off checklist — COMPLETE

INFLIGHT PROCEDURES — ALL ARMAMENT.

The following armament inflight procedures paragraphs are based on only one weapon installed, all armament circuit breakers in pilot RECOIL COMP, switch on. Refer to FO-8 for firing modes when two or more weapons are installed.

WARNING

Do not engage cyclic or LHG switches during any switching action on armament control panels.

CAUTION

- If weapon firing stoppage occurs, immediately release firing switch or extensive damage to equipment may occur. Do not attempt to fire weapon until stoppage corrective action has been taken.
- In the event of runaway gun, place MASTER ARM/PILOT OVERRIDE switch OFF.

Turret Operation.

GUNNER OPERATION — TURRET.

1. Pilot MASTER ARM — ARM
2. Pilot WEAPON CONT — GUNNER
3. Pilot RECOIL COMP — ON
4. Gunner PILOT OVERRIDE — OFF
5. Gunner RANGE — AS DESIRED
6. Gunner AIRSPEED COMP — COMP
7. Gunner TURRET DEPR LIMIT — OFF
8. Gunner to use HS
   a. TCP MODE SELECT — OFF

   or

   b. TCP MODE SELECT — TSU/GUN

c. ACQ/TRK/STOW — STOW

or

d. PILOT OVERRIDE — OVERRIDE

e. Cyclic turret switches — UTILIZE VICE LHG TURRET SWITCHES

9. Gunner to use TSU/GUN

a. TCP Mode Select — TSU/GUN

b. ACQ/TRK/STOW — TRK

c. VIEW through TSU to fire

10. Gunner LHG ACTION — DEPRESSED

11. Gunner HS/TSU recticle — ON TARGET

12. Gunner LHG TRIGGER — DEPRESSED. First detent 16 ± 4 round burst, second detent continuous.

NOTE

The pilot can interrupt firing by deenergizing the appropriate circuit breaker, or depressing the cyclic TRIGGER ACTION Switch.

PILOT OPERATION — TURRET.

1. Pilot MASTER ARM — ARM
2. Pilot RECOIL COMP — ON
3. Gunner PILOT OVERRIDE — OFF
4. Pilot RANGE — AS DESIRED
5. Gunner AIRSPEED COMP — COMP
6. Gunner TURRET DEPR LIMIT — OFF.

When using HS:

1. Pilot WEAPON CONT — PILOT
2. Pilot cyclic TRIGGER ACTION — DEPRESSED (If not depressed gun will fire from lower stow.)
4. Pilot cyclic TRIGGER TURRET FIRE — DEPRESSED
   First detent 16±4 round burst, second detent continuous.

When using fixed sight:

1. Pilot WEAPON control — FIXED
2. Pilot sight — SET
3. Pilot sight reticle — ON TARGET
4. Pilot cyclic TRIGGER ACTION — DEPRESSED.
5. Pilot cyclic TRIGGER TURRET FIRE — DEPRESSED.
   First detent 16±4 round burst, second detent continuous.

NOTE

With weapon control in gunner and TCP mode select in a TOW mode, the pilot will have control of the turret and can fire from lower stow or utilize his HS.

WARNING

When the gunner comes out of the TSU, the LHG mag switch should be placed in LO mag and ACQ/TRK/STOW to STOW to prevent firing of system in undesired mode.

TOW Operation.

1. MASTER ARM — STBY
2. Pilot WEAPON CON — GUNNER
3. TCP MODE SELECT — ARMED MAN OR AUTO
4. MISSILE SELECT — SET AND INDICATES SEL
5. ACQ/TRK/STOW — TRK
6. PHS ACQ — DEPRESS FOR PHS ACQ THEN RELEASE WHEN TARGET ACQUIRED
7. ACQ/TRK/STOW — ACQ FOR GHS ACQ THEN RELEASE

8. LHG ACTION — DEPRESS

9. MAG switch — HI AFTER TARGET IS IN HI MAG FIELD OF VIEW

10. AIRCRAFT — MANEUVER INTO PRE-LAUNCH CONSTRAINTS AS INDICATED BY PSI

11. MASTER ARM — ARM

12. LHG TRIGGER — DEPRESS

13. LHG TRIGGER — RELEASE

14. MASTER ARM — STBY.

WARNING

LHG TRIGGER shall be released after missile launch to prevent inadvertent firing of next missile.

Jettisoning of TOW launchers for a misfire condition is extremely dangerous; do not jettison launcher unless fire is encountered.

NOTE

- Smoke may emerge from launcher after TRIGGER is depressed and before missile exits launcher. Smoke is caused by missile gyro and battery squibs firing and should not be regarded as a misfire.
- If TOW missile fails to exit from the launcher within 1.5 seconds and the PSI RDY annunciator disappears, a misfire has occurred.
- Gunner may attempt second firing by releasing and depressing LHG TRIGGER; if TOW missile again fails to fire, set TCP, MISSILE SELECT switch to select another TOW missile.
- Gunner cannot fire if helicopter is not within prelaunch constraints boundary. Gunner can override prelaunch constraint boundary limitation by pressing CONST OVRD switch on the SHC. If this mode of operation is employed, degraded system performance can be expected.

15. Helicopter — MANEUVER. Keep pilot PSI sightline position bars within postlaunch constraint boundary until wire cut or missile impact.

NOTE

- Loss of missile guidance could result if postlaunch constraints are exceeded.
- Missile wires are cut automatically and PSI FIRE annunciator disappears. If wires are not automatically cut, the pilot can manually cut the wires using the PILOT WIRE CUT switch or gunner can manually cut wires using TCP WIRE CUT switch.

Additional missile firing — Next missile is selected automatically when gunner TCP MODE SELECT IN ARMED AUTO; manually in ARMED MAN.

Rocket Operation.

1. Pilot MASTER ARM — ARM
2. Gunner PILOT OVERRIDE — OFF
3. Pilot STATION SELECT — SELECT
4. Pilot RATE — AS DESIRED
5. Pilot QTY — AS DESIRED
6. Pilot MODE — AS DESIRED
7. Pilot cyclic WING ARM FIRE — DEPRESSED.

Wing Gun Pod Operation.

1. Pilot MASTER ARM — ARM
2. Gunner PILOT OVERRIDE — OFF
3. Pilot STATION SELECT — SELECT
4. Pilot sight — ON TARGET
5. Pilot cyclic WING ARM FIRE — DEPRESSED.

Smoke Grenade Dispenser Operation.

1. Pilot MASTER ARM — STBY or ARM
2. Pilot LH and RH ARM — AS DESIRED

3. Pilot SMOKE RELEASE — DEPRESS.

Bomb Operation.

1. Pilot MASTER ARM — ARM
2. Gunner PILOT OVERRIDE — OFF
3. Pilot STATION SELECT — SELECT
4. Pilot BOMB ARM — AS DESIRED
5. Pilot cyclic WING ARM FIRE — DEPRESSED.

Flare Operation.

1. Pilot MASTER ARM — ARM
2. Gunner PILOT OVERRIDE — OFF
3. Pilot STATION SELECT — SELECT
4. Pilot cyclic WING ARM FIRE — DEPRESSED.

POST FIRING/BEFORE LANDING CHECK — ALL ARMAMENT.

1. TCP MODE SELECT — OFF
2. PILOT OVERRIDE — OFF
3. TURRET DEPR LIMIT — LIMIT
4. MASTER ARM — OFF
5. WEAPON CONTROL — FIXED
   a. ARM switch — SAFE
   b. PWR switch — ARM
6. Armed/CP lights — EXTINGUISHED
7. Turret stow lights — ILLUMINATED
8. Armament circuit breakers — DE-ENERGIZED.

After Dearm.

1. RADALT/TACAN/IFF — AS DESIRED
2. Take-off checklist — COMPLETE

AN/ALE-39 COUNTERMEASURES DISPENSING SYSTEM.

The AN/ALE-39 Countermeasures Dispensing System (figure 8-23) permits the pilot or copilot to selectively eject flares, chaff, or active radio devices (jammers) from dispensing pods on the stub wings. These items are designed to defeat enemy surveillance radar, missile guidance radar, and passive homing missiles. The AN/ALE-39 has the capability of dispensing up to sixty chaff, flare, and jammer payloads loaded in any combination in multiples of ten. All three types of payloads can be dispensed in both manual (single) and automatic (programmed) modes independently or simultaneously. The dispensing function can be initiated by the pilot, copilot, or a radar warning receiver system. The AN/ALE-39 system consists of two dispenser housings, two dispenser assemblies, two pilot and copilot actuator switches, two sequencer switch assemblies, one programmer assembly, one ALE-39 control panel, and one ALE—39 arm voltage control.

Countermeasures Dispensing System Operating Procedures.

1. DISP and CONT cricuit breaker — IN
2. ALE-39 PWR switch — ON
3. ALE-39 ARM switch — ARM
4. MODE SEL — AS REQUIRED
5. Pilot/copilot DISPENSER switch — AS REQUIRED.

AN/APR-39 RADAR WARNING SYSTEM.

The AN/APR-39(V) 1 is a passive omnidirectional radar warning system receiving and displaying information to the pilot concerning the radar environment surrounding the aircraft. The equipment responds to radar signals associated with hostile fire control radar in E, F, G, H, I and J frequency bands (wide-band) and provides visual and aural indications of the presence and direction of emitters. Radar signals which are not hostile are generally excluded.

Missile guidance radar signals in C and D bands are also received by this system. When a low-band signal is correlated with a tracking radar signal, the equipment identifies the combination as an activated SAM radar complex. This system consists of four spiral antennas, one blade antenna, a comparator, an APR-39 control panel, two receivers and an APR-39 radar signal indicator.

The control panel (figure 8-24) is located on the right side of the pilot's glare shield. System control and test functions are provided by this unit.

Radar Warning System Operating Procedures.

1. Radar WRN circuit breaker — IN
2. DSCRM switch — OFF
3. PWR-ON/OFF switch — ON
   Allow a minimum of 30 seconds for equipment to become fully operational.
4. Audio — ON
5. IFF-Intercom switch — ON
6. Self-test switch — DEPRESS
   a. Adjust BRIL and filter
   b. Adjust AUDIO to desired level
7. DSCRM switch — AS REQUIRED.

• CAUTION

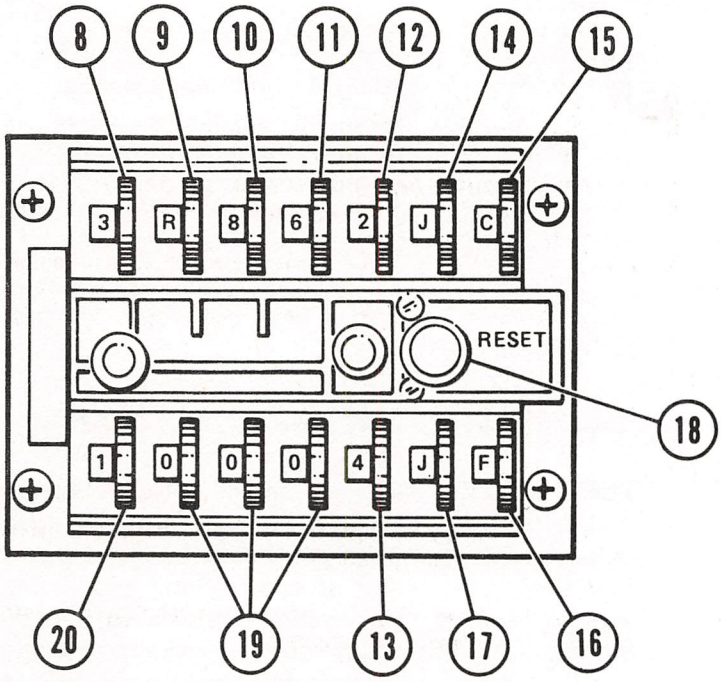
To prevent damage to the receiver detector crystals, ensure that the AN/APR-39 antenna are at least 60 yards from active ground based radar antenna, or 6 yards from active airborne radar antenna. Allow an extra margin for new, unusual, or high powered antennas.

AN/ALQ-144 COUNTERMEASURES SYSTEM.

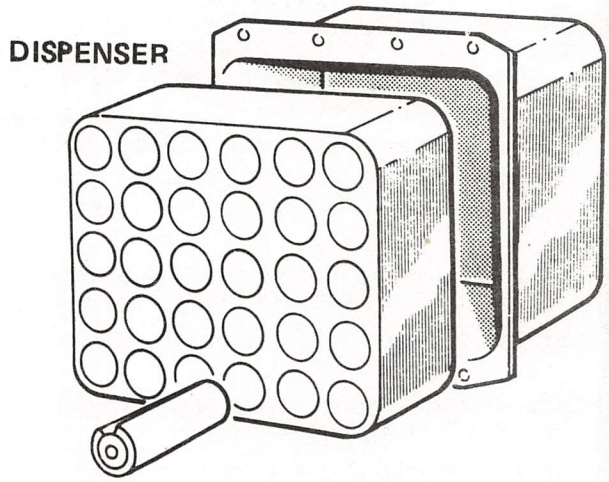
The AN/ALQ-144 is an active countermeasures system which provides mechanical modulation of radiation from an electrically heated source designed to defeat the homing of approaching hostile heat seeking missiles. The system consists of a transmitter, an operator control unit, and a bus transfer relay assembly. The operator control unit (figure FO-6) is positioned at the bottom of the armament control panel between the pilot's legs. Control, operating test, and display functions are provided by this unit. Control is provided by an ON/OFF switch (figure 8-25) which activates the system by applying 28 vdc power.

IR Jammer Operating Procedure.

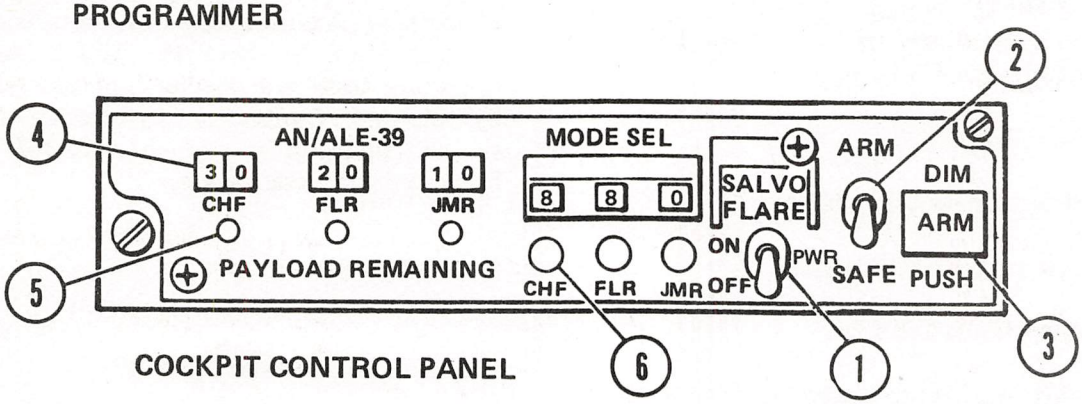
1. IR JAMMER (XMTR, CONT, BASE) circuit breakers — IN
2. ON/OFF switch — ON
   If an INOP condition is indicated by illumination of the IRCM light located adjacent to the pilot's sight, de-energize the transmitter by setting the ON/OFF switch to OFF.



PROGRAMMER



DISPENSER HOUSING



COCKPIT CONTROL PANEL

NOMENCLATURE	FUNCTION
1. Power switch	OFF – Power off to ALE-39 ON – Activates ALE-39 Salvo Flare – Fires all flares in dispensers
2. ALE-39 Arm switch	OFF – Disables ALE-39 ON – Master arm switch for ALE-39
3. Arm light	Extinguished when Switch #2 is OFF or when Switch #2 is on dispensers installed. Armed light is on when switch ON and ARM pin removed.
4. Counters	Indicates sumber of payloads, by type, remaining in dispensers. C – chaff F – flare J – rf jammer
5. Payload reset	Sets quantity of each type of payload loaded.

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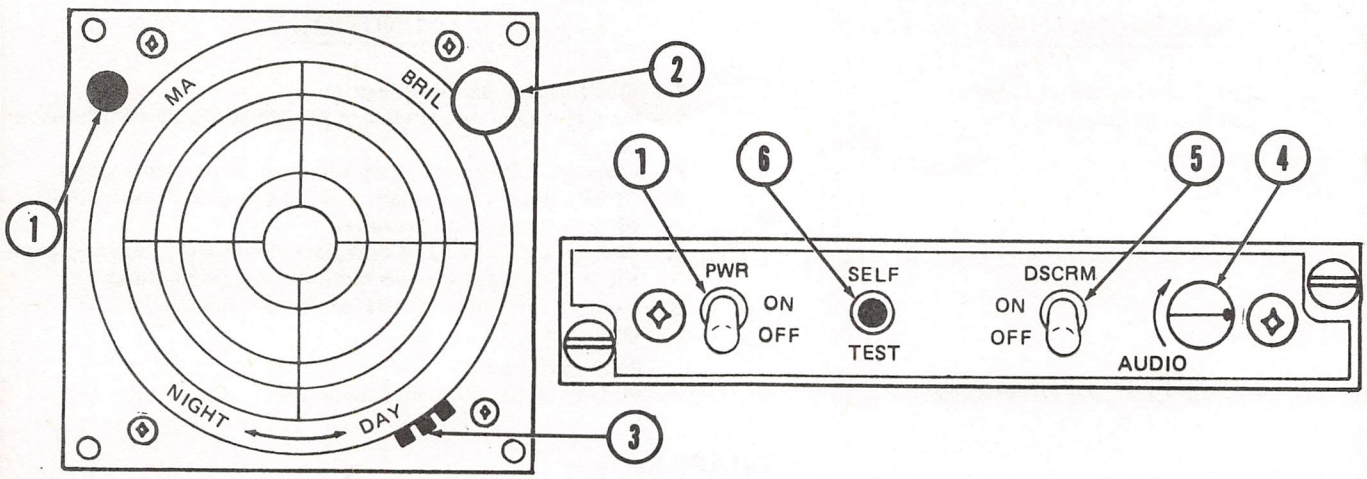
Figure 8-23. Countermeasures Dispensing System (Sheet 1 of 2)

	NOMENCLATURE	FUNCTION
6.	Mode Select switches (one for each countermeasure)	O – Disables that countermeasure S – Single, one countermeasure per actuation of pilot jettison switch P – Program, initiates program sequence as per programmer R – RWR, series of payloads will be dispensed under control of the radar warning receiver M – Multiple, burst of 2, 3 or 4 flares in parallel, depending on the number of dispenser sections containing flares G – Group, multiple bursts of flares dispensed as per programmer
7.	Dispenser switches pilot/copilot	Push to dispense Push to initiate dispense sequence
	CHAFF Section	
8.	B QTY switch	1, 2, 3, 4, C, or R selects number of chaff bursts in one salvo (C is continuous and R is random).
9.	B INTV switch	1, 2, 5, 7, 10 or R selects time interval between chaff bursts of each salvo in seconds (R is random).
10.	S QTY switch	1, 2, 4, 8, 10, or 15 selects number of chaff salvos required to end programmed sequence.
11.	S INTV switch	2, 4, 6, 8, or 10 selects time interval between chaff salvos in seconds
	FLARE Section	
12.	QTY switch	2, 3, 4, 6, 8, or 10 selects number of flare bursts required to end flare programmed sequence.
13.	INTV switch	2, 4, 6, 8, or 10 selects time interval, in seconds, between bursts in programmed sequence.
	LOAD Section	
14.	L10 switch	C, F, or J indicates type of payload in L10 dispenser.
15.	L20 switch	C, F, or J indicates type of payload in L20 dispenser.
16.	R20 switch	C, F, or J indicates type of payload in R20 dispenser.
17.	R10 switch	C, F, or J indicates type of payload in R10 dispenser.
18.	RESET switch	When pressed (3 seconds minimum) clears all registers and counters in programmer and resets sequencer switches.
	JAMMER Section	
19.	INTV switches	Selects in seconds the time interval between bursts of programmed sequence (continuous from 000 thru 299).
20.	QTY switch	1, 2, 3, or 4 selects number of jammer bursts required to end programmed sequence.

*Refer to NAVAIR 16-30A39-1, Intermediate Maintenance Manual, for a discussion of programmer operation.

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Figure 8-23. Countermeasures Dispensing System (Sheet 2 of 2)



CONTROL/INDICATOR	FUNCTION
1. MA indicator	Flashing indicates high radar missile threat with DSCRM switch is ON.
2. BRIL control	Adjusts indicator illumination.
3. NIGHT–DAY control	Adjust indicator intensity.
4. AUDIO control	Adjusts radar warning audio volume.
5. DSCRM switch:	
OFF	Without missile activity – Provides strobe lines for ground radar and normal audio indications.
	With missile activity – Provides strobe lines for ground radar, flashing strobe line(s) for missile activity, and flashing MA (missile alert) light.
ON	Without missile activity – No indications.
	With missile activity – Flashing strobe lines for missile activity (no strobe lines for ground radar), flashing MA light, and audio warning.
6. SELF TEST switch:	
with DSCRM switch OFF PWR switch ON. (NOTE: One minute warmup) Monitor CRT and audio & press and hold SELF TEST	Forward and aft strobes appear, extending to approximately the third circle on the indicator graticule and 2.5 kHz PRF audio present immediately.
Rotate indicator BRIL control CW & CCW	Within approximately 6 seconds, alarm audio present and MA lamp starts flashing.
Rotate control unit AUDIO control between maximum CCW and maximum CW	Indicator strobes brighten (CW) and dim as control is rotated.
Release SELF TEST	AUDIOS not audible at maximum CCW and clearly audible at maximum CW.
Set DSCRM to ON. Press & hold SELF TEST	All indications cease. Within approximately 4 seconds, a FWD or AFT strobe and 1.2 kHz PRF audio present. Within approximately 6 seconds, the other strobe will appear and APRF audio will double.
7. PWR switch:	
ON	Applies power to radar set.
OFF	De-energizes radar set.

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Figure 8-24. Radar Warning Indicator and Control AN/APR-39

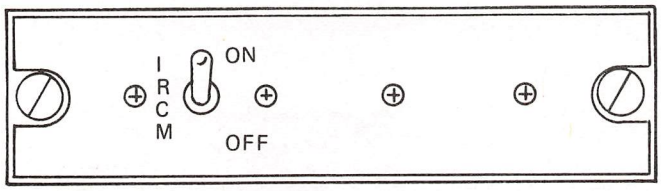
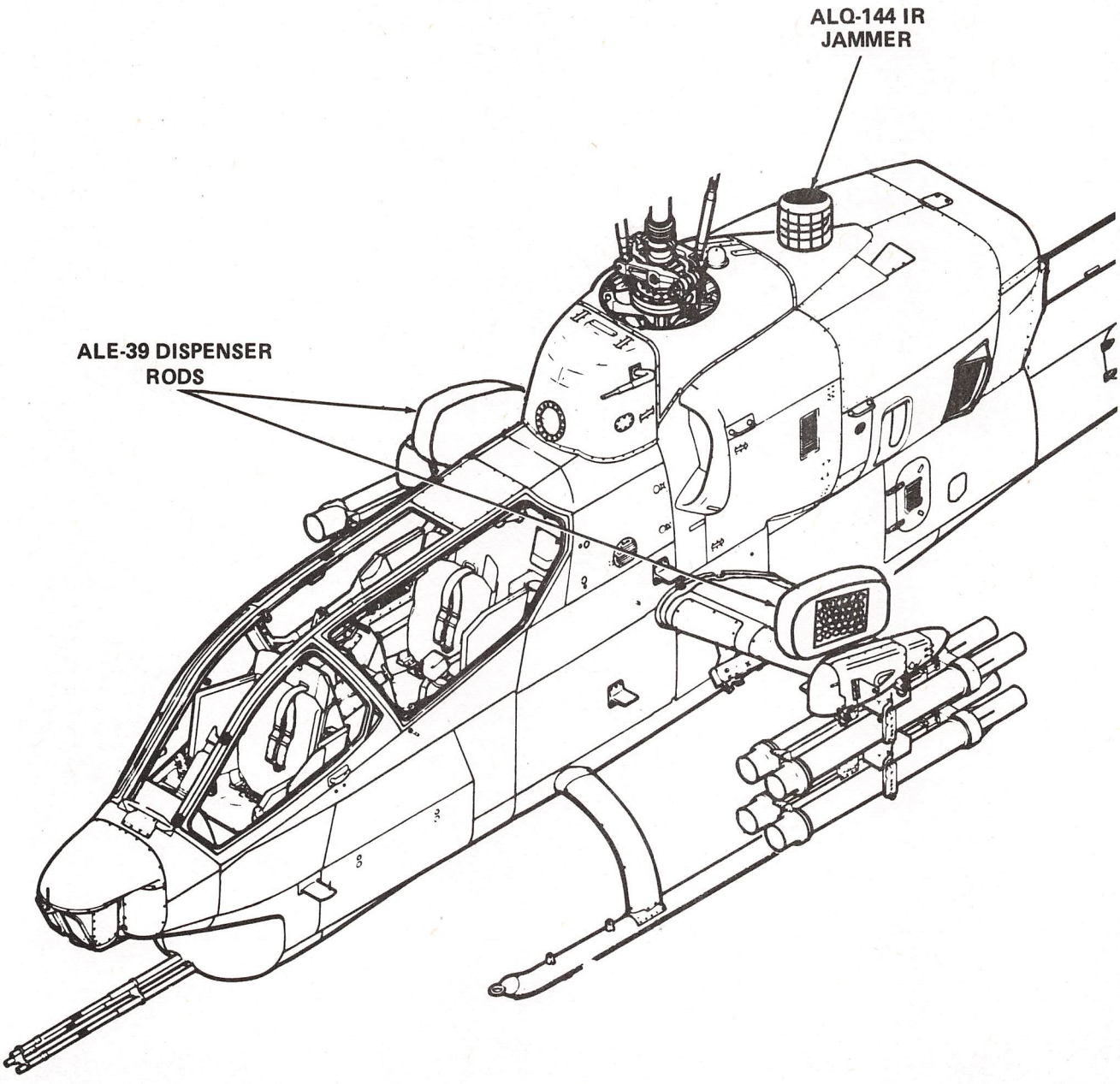


Figure 8-25. AN/ALQ-144 IR Jammer System Control



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Figure 8-26. Countermeasure Equipment

SECTION IX — FLIGHT CREW COORDINATION

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INTRODUCTION

While the AH-1T (TOW) can be flown single pilot, the combat mission requires two pilots to occupy the crew positions. A qualified observer or enlisted non-crewmember may occupy the front cockpits on some flights not requiring crew duties of that person. Coordination between the two personnel occupying the crew positions is absolutely necessary to enhance the mission capability and safety of the crew.

Observer.

Any person, authorized by the commanding officer or his designated deputy, may occupy the front cockpit if the following requirements are met:

1. Must complete an egress drill.
2. Must be fully briefed on the front cockpit.
3. Must have a current physical.
4. Must be fully briefed on what is expected of him during the flight to include but not be limited to:
   a. Be alert for other aircraft or obstacles to flight.
   b. Operating altitudes.
   c. Mission plan.
   d. Actions during an emergency.
   e. Lost communication with the pilot.

Non-crewmembers.

Non-crewmembers are designated in writing by the commanding officer and are assigned to temporary-definite orders involving flying. Those personnel are the only personnel that shall fly, occupying the front crew position in a non-crew status. In addition to receiving the same information; prior to flight, as outlined in the observer paragraph, he will perform duties as directed by the aircraft commander. Those duties may include but are not limited to:

1. Assisting the aircraft commander in preparing the aircraft for flight.
2. Acting as an observer.
3. Recording data as directed by the aircraft commander.

Non-crewmembers shall meet the following requirements and all others required by applicable directives:

1. Must have a current flight physical.
2. Must be a 2nd class or better swimmer.
3. Must have current physiology training.
4. Must have current WST training.

These requirements are not to be interpreted as limiting in any way the establishment of higher

requirements by proper authority. Non-crewmembers ground training should include but not be limited to:

1. Ground handling — Instructions in the operation and use of all ground support equipment, aircraft towing, and tiedown procedures (aircraft security). Instructions in the use of proper taxi director signals, both day and night.

2. Fueling and servicing — Instructions in the proper fueling and servicing procedures with particular emphasis on safety precautions, fuel contaminations, alternate fuels, oils, and lubricants.

3. Equipment stowage — Instructions in the proper location and stowage of loose equipment.

4. Helicopter inspection — Instructions in assisting the aircraft commander in inspecting the aircraft and securing aircraft panels, doors, etc.

5. Fire guard — Instructions in procedures for performing duties of fire guard during starts.

WARNING

The fire guard will remain clear of the tip path plane, engine compressor, and engine turbine areas during start.

TACTICAL MISSIONS/TRAINING.

To enhance the mission capability of the AH-1T (TOW), both pilots shall fully understand all duties expected of him during the mission. By dividing the duties required of crew, individual workloads will be minimized. For example: The pilot that is not controlling the aircraft should allow the other pilot to copy all required communications. No attempt is made here to cover all situations as the complexity and variance of the AH-1 tasks is great. However, the crew shall divide as many duties as is practical, limited only by individual experiences and proficiency at certain tasks.

Standard Terminology.

Much confusion can result in the cockpit due to the non-standardized communication. Communication with air traffic control agencies shall be standardized in accordance with applicable directives. Inner cockpit voice procedures should be standardized by the units to expedite the communication and rule out misunderstandings. As an example: "I've got it", a much used term, should not be used. The following terminology may be used and will rule out any confusion as to the action being taken:

1. "I've got the traffic."

2. "I've got the controls."

3. "I've got the fuel switch."

4. "I've got the brief."

5. "I've got the obstacles."

Communications shall be expeditious, clear, concise, and understood by both crewmembers.

TOW Mission Coordination.

Due to the complexity of the TMS on the AH-1T (TOW), cockpit workloads for both pilots have increased over the standard AH-1T. When the co-pilot is utilizing the TSU, he is totally oriented on that system and cannot aid the pilot in any other task, such as, navigation, obstacle avoidance, or communications. The following procedures are recommended to expedite communication, target acquisition, and employment of the TMS.

GUNNER ACQUISITION.

1. Gunner acquires target with GHS and states, "GUNNER ACQ".

2. Pilot states, "ROGER ACQ," and attempts to give the gunner as stable a platform as possible to acquire the target. By noting the gunner's head position, the pilot can determine the direction in which the aircraft must be maneuvered to get into pre-launch constraints.

3. When the gunner acquires the target through the TSU, he states, "TARGET ACQ".

PILOT ACQUISITION.

1. When the pilot has acquired a target with the PHS, he states, "PILOT ACQ".

2. The gunner acknowledges, "ROGER, PILOT ACQ", looks through the TSU and depresses the PHS ACQ button. (The pilot may have to describe the target).

3. When the gunner acquires the target he states, "TARGET ACQ" and releases the PHS ACQ button. Until the gunner states, "TARGET ACQ", the pilot must hold his PHS reticle on the target.

TOW LAUNCH.

1. When the ATTK indicator appears on the PSI the pilot states, "ATTACK".

2. The gunner should direct the pilot to maneuver the aircraft if an obstacle masks the target, or if a more desirable line of flight can be achieved to minimize aircraft exposure. He should do this by stating, "COME UP, COME DOWN, COME LEFT OR COME RIGHT." The pilot should also communicate to the gunner the need for maneuvering the aircraft to a more desirable firing position.

3. If wind conditions in a hover position necessitate momentarily rocking into constraints, the pilot shall state, "ROCKING INTO PITCH (OR ROLL)." If a steady constraints is necessary, the pilot shall state, "DRIFTING RIGHT (OR FORWARD) etc."

4. When the pilot has an indication of system armed, ATTACK flag, and he is ready for the gunner to fire, he will state, "CLEARED TO FIRE". At this time, if the "ROCKING INTO CONSTRAINTS" was given, the gunner should hold the LHG TRIGGER down to initiate the launch when constraints are achieved.

5. After launch the pilot should keep the gunner apprised as to the direction of aircraft maneuvering. The gunner should roger unless it appears to interfere with the TSU to target line of sight. In that case, he should state, "NEGATIVE, COME LEFT, RIGHT, etc."

6. At wire cut the pilot who first notes it should so state. If wire cut is caused by missile impact the gunner should state, "IMPACT". At extended ranges, the pilot should not attempt to discern whether the impact was the missile or fire from another source.

SECTION X — NATOPS EVALUATION

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CONCEPT.

The standard operating procedures prescribed in this manual represent the optimum method of operating AH-1T aircraft. The NATOPS Evaluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatibility with various operational commitments and missions of both Navy and Marine Corps units. The prime objective of the NATOPS Evaluation program is to assist the unit commanding officer in improving unit readiness and safety through constructive comment. Maximum benefit from the NATOPS Program is achieved only through the active vigorous support of all pilots and flight crewmembers.

IMPLEMENTATION.

The NATOPS Evaluation program shall be carried out in every unit operating naval aircraft. The various categories of flight crewmembers desiring to attain/retain qualification in the AH-1T shall be evaluated in accordance with OPNAV Instruction 3510.9 series. Individual and unit NATOPS Evaluations will be conducted periodically; however, instructions in and observation of adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS coordinators, Evaluators, and Instructors shall administer the program as outlined in OPNAVINST 3510.9 series. Evaluees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a re-evaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

DEFINITIONS.

The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS program.

NATOPS Evaluation.

A periodic evaluation of individual flight crewmember standardization consisting of an open book examination, a closed book examination, an oral examination, and a flight evaluation.

NATOPS Re-evaluation.

A partial NATOPS Evaluation administered to a flight crewmember who has been placed in an Unqualified status by receiving an Unqualified grade for any of his ground examinations or the flight evaluation. Only those areas in which an unsatisfactory level was noted need be observed during a re-evaluation.

Qualified.

That degree of standardization demonstrated by a very reliable flight crewmember who has a good knowledge of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

Conditionally Qualified.

That degree of standardization demonstrated by a flight crewmember who meets the minimum acceptable standards. He is considered safe enough to fly as a pilot in command or to perform normal duties

without supervision but more practice is needed to become Qualified.

Unqualified.

That degree of standardization demonstrated by a flight crewmember who fails to meet minimum acceptable criteria. He should receive supervised instruction until he has achieved a grade of Qualified or Conditionally Qualified.

Area.

A routine of preflight, flight, or postflight.

Sub-Area.

A performance sub-division within an area, which is observed and evaluated.

Critical Area/Sub-Area.

Any area or sub-area which covers items of significant importance to the over-all mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

Emergency.

An aircraft component, system failure, or condition which requires instantaneous recognition, analysis, and proper action.

Malfunction.

An aircraft component or system failure or condition which requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

GROUND EVALUATION.

Prior to commencing the flight evaluation, an evaluee must achieve a minimum grade of Qualified on the open book and closed book examinations. The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation. To assure a degree of standardization between units, the NATOPS Instructors may use the bank of questions contained in this section in preparing portions of the written examinations.

Open Book Examination.

The open book examination may consist of but shall not be limited to the questions from the question bank. The number of questions shall not exceed that of the question bank nor be less than 50. The purpose of the open book examination portion of the written examination is to evaluate the crewmembers knowledge of appropriate publications and the aircraft. The maximum time for this examination should not exceed seven days.

Closed Book Examination.

The closed book examination may consist of but shall not be limited to the questions from the question bank. The number of questions on the examination will not exceed 40 or be less than 20. Questions designated critical will be so marked. An incorrect answer to any question in the critical category will result in a grade of unqualified being assigned to the examination.

Oral Examination.

The questions may be taken from this manual and drawn from the experience of the Instructor/evaluator. Such questions should be direct and positive and should in no way be opinionated.

OFT/WST Procedures Evaluation (If Applicable).

An OFT may be used to assist in measuring the crewmembers efficiency in the execution of normal operating procedures and his reaction to emergencies and malfunctions. In areas not served by these facilities, this may be done by placing the crewmember in an aircraft and administering appropriate questions.

GRADING INSTRUCTIONS.

Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

Open Book Examination.

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5.

Closed Book Examination.

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3.

Oral Examination and Oft Procedure Check.

(If conducted.)

A grade of Qualified or Unqualified shall be assigned by the Instructor/Evaluator.

FLIGHT EVALUATION.

The NATOPS flight evaluation is intended to evaluate unit/individual compliance with approved standardized operating procedures. The successful completion of all ground evaluations and examinations is required prior to commencement of the flight evaluation. Insofar as possible, evaluation flights will be scheduled so as not to interfere with squadron operations. The flight evaluation should conform to any syllabus flight. Only those areas observed or required by the mission will be evaluated. Determination of the final flight evaluation grade will be made as outlined in the Final Grade Determination section.

NOTE

Areas/sub-areas to be evaluated are listed. Critical areas/sub-areas are marked by an asterisk.

Pilot's Nontactical Flight Evaluation.

MISSION PLANNING.

1. Flight plan.
2. Computation card.
3. Weather.

BRIEFING.

PREFLIGHT.

1. Records check.
2. Preflight check.
3. Crew briefing.

ENGINE AND ROTOR START.

1. Start.
2. Post start.

AIR TAXI.

1. Taxi.

TAKEOFF/TRANSITION.

1. Procedures.
2. Type takeoff.
   a. Vertical.
   b. Cross-wind.
   c. Maximum gross.
3. Transition.

CLIMB/CRUISE.

1. Procedures.
2. Power control.
3. Helicopter control.

APPROACH AND LANDING.

1. Procedures.
2. Power control.
3. Helicopter control.
4. Type of landing:
   a. Vertical.
   b. Running.
   c. Cross-wind.
   D. Maximum gross.

AUTOROTATION*.

1. Procedures.
2. RPM control.
3. Airspeed control.
4. Recovery.

EMERGENCY PROCEDURES*

1. Procedures.

2. Helicopter control.

CREW COORDINATION.

DEBRIEFING.

MISSION FLIGHT EVALUATION.

CONFINED AREA LANDING PRECISION APPROACH.

1. Procedures.

2. Approach.

3. Power control.

4. Helicopter control.

NAVIGATION.

SEARCH AND RESCUE.

SPECIAL.

Crewmember — Evaluation areas.

1. Preflight.

2. Security.

3. Ground safety precautions.

4. Hand signals.

5. Fueling and servicing of aircraft.

6. Post flight.

7. Emergency Procedures*.

8. Rescue operations (coordination and cover).

FLIGHT EVALUATION GRADING CRITERIA.

Only those sub-areas provided or required will be graded. The grades assigned for a sub-area shall be determined by comparing the degree of adherence to standard operating procedures with adjectival ratings listed below. Momentary deviations from standard operating procedures should not be considered as unqualifiying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action.

Qualified.

Well standardized evaluee demonstrated highly professional knowledge of and compliance with NATOPS standards and procedures; momentary deviations from or minor omissions in non-critical areas are permitted if prompt at timely remedial action is initiated by the evaluee.

Conditionally Qualified.

Satisfactorily standardized; one or more significant deviations from NATOPS standards and procedures, but no errors in critical areas and no errors jeopardize mission accomplishment of flight safety.

Unqualified.

Not acceptably standardized; evaluee fails to meet minimum standards regarding knowledge of and/or ability to apply NATOPS procedures; one or more significant deviations from NATOPS standards and procedures which could jeopardize mission accomplishment or flight safety.

Flight Evaluation Grade Determination.

The following procedure shall be used in determining the flight evaluation grade: A grade of Unqualified in any critical area/sub-area will result in an overall grade of Unqualified for the flight. Otherwise, flight evaluation (or area) grades shall be determined by assigning the following numerical equivalents to the adjective grade for each sub-area. Only the numerals 0, 2, or 4, will be assigned in sub-areas. No interpolation is allowed.

Unqualified 0.0
Conditionally Qualified 2.0
Qualified 4.0

To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the sub-areas and divide this sum by the

number of sub-areas graded. The adjective grade shall then be determined on the basis of the following scale.

0.0 to 2.19 .....Unqualified

2.2 to 2.99 .....Conditionally Qualified

3.0 to 4.0 .....Qualified

EXAMPLE: (Add Sub-area numerical equivalents)

$$\frac{4 + 2 + 4 + 2 + 4}{5} = \frac{16}{5} = 3.20 \text{ Qualified}$$

FINAL GRADE DETERMINATION

The final NATOPS Evaluation grade shall be the same as the grade assigned to the flight evaluation. An evaluee who receives an Unqualified on any ground examination or the flight evaluation shall be placed in an Unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a re-evaluation.

RECORDS AND REPORTS

A NATOPS Evaluation report (OPNAV Form 3510-8) shall be completed for each evaluation and forwarded to the evaluee's commanding officer. Refer to figure 10-1.

This report shall be filed in the individual flight training record and retained therein for 18 months. In addition, an entry shall be made in the pilot/NFO flight log book under "Qualifications and Achievements" as follows:

QUALIFICATION			DATE	SIGNATURE	
NATOPS EVAL.	(Aircraft Model)	(Crew Position)	(Date)	(Authenticating Signature)	(Unit which Administered Eval.)

NATOPS EVALUATION REPORT (OPNAV FORM 3510-8)

NATOPS EVALUATION REPORT
OPNAV FORM 3510/8 (REV. 10-73) S/N 0107-LF-723-0001 REPORT SYMBOL OPNAV 3510-3

NAME (Last, First Initial)	GRADE	SSN
SQUADRON/UNIT	AIRCRAFT MODEL	CREW POSITION
TOTAL PILOT/FLIGHT HOURS	TOTAL HOURS IN MODEL	DATE OF LAST EVALUATION

NATOPS EVALUATION

REQUIREMENT	DATE COMPLETED	GRADE		
		Q	CQ	U
OPEN BOOK EXAMINATION				
CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
*EVALUATION FLIGHT				

FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE

REMARKS OF EVALUATOR/INSTRUCTOR

☐ CHECK IF CONTINUED ON REVERSE SIDE

GRADE, NAME OF EVALUATOR/INSTRUCTOR	SIGNATURE	DATE
GRADE, NAME OF EVALUEE	SIGNATURE	DATE

REMARKS OF UNIT COMMANDER

RANK, NAME OF UNIT COMMANDER	SIGNATURE	DATE

*WST, OFT, COT, or cockpit check in accordance with OPNAVINST 3510.9E

AP 002147

Figure 10-1. NATOPS Evaluation Report (OPNAV Form 3510/8)

Name _____

Date _____

Score _____

AH-1T TOW NATOPS OPEN BOOK EXAM

1. Should conflict exist between the NATOPS Flight Manual and other publications, the NATOPS Flight Manual shall govern. TRUE/FALSE.

2. Anyone can recommend a change to NATOPS. TRUE/FALSE.

3. A WARNING as defined in NATOPS, as an operating procedure or technique which may _____

4. The T400-WV-402 engine is a twin power section turboshaft engine consisting of _____ _____ sections driving a single output shaft through separate halves of a common _____.

5. Max gross weight of the AH-1T (TOW) is _____ pounds.

6. The AH-1T has a rotor diameter of _____ feet and an overall length with the main rotor in the fore and aft position, and the tail rotor in the horizontal position of _____ feet.

7. The compressor section of the T400-WV-402 engine contains _____ axial and _____ centrifugal stages.

8. Fuel is sprayed into the annular combustion change by _____ fuel nozzles.

9. The _____ oil cooler system has an automatic emergency oil cooler bypass valve that routes the oil around the oil cooler or lines, if the oil cooler or lines are ruptured.

10. There are _____ independent oil systems within the power plant.

11. A _____ second delay is built into the engine idle stop release switch to allow time to _____ or _____ throttle.

12. The torquemeter system receives power from the _____ bus and is protected by the _____ circuit breaker.

13. The triple tachometer is powered by the 115 vac essential bus. TRUE/FALSE.

14. During a complete electrical failure there will be no indication of rotor RPM. TRUE/FALSE.

15. The gas producer turbine tachometers operate independently of the electrical system. TRUE/FALSE.

16. The combining gearbox oil system does not incorporate an oil hot caution light. TRUE/FALSE.

17. The transmission oil bypass valve closes automatically because of _____ flow between the pump and _____ outlet.

18. The fuel boost pumps are powered by the _____ bus _____.

19. Movement of either fuel switch to ON energizes both fuel boost pumps. TRUE/FALSE.

20. With the crossfeed valve closed, the forward cell supplies engine ____ only and the aft cell supplies engine ____ only.

21. The fuel pressure indicator reads _____ pump pressure.

22. In the event of a fuel filter caution light, if clogging continues, the _____ opens to allow fuel to _____ the clogged filter.

23. With the FUEL TANK INTCON switch in the CLOSE position, the AFT FUEL LOW light illuminates when _____ pounds of fuel remains.

24. One air pump can pressurize both auxiliary fuel tanks if a failure of one pump occurs. TRUE/FALSE.

25. Power for turret control and firing is supplied by the No. _____ generator.

26. In the event of failure of the No. 2 generator while supplying turret power, the _____ will automatically switch to supply turret power. The main bus is then supplied by the _____.

27. The primary electrical power supply system is a _____ single-wire, negative-ground _____ arrangement supplied by two _____ , 200 ampere _____ , one mounted on each engine.

28. When the NON-ESS BUS switch is in NORMAL, power is supplied to the non-essential bus as long as _____ is operating.

29. In the event of a MAIN inverter failure, use of the TACAN can be regained by placing the NON-ESS BUS switch in MANUAL. TRUE/FALSE.

30. The external power receptacle incorporates overvoltage protection. TRUE/FALSE.

31. The hydraulic pumps deliver _____ psi output pressure at _____ rpm.

32. Hydraulic system No. 1 supplies system power for the _____ , _____ , and _____ actuators and the _____ SCAS actuator.

33. The rotor brake is powered by the No. _____ hydraulic system.

34. The hydraulic filter indicator will pop out when the differential pressure across the filter element exceeds _____ psi.

35. The SCAS channel engage switches energize electric _____ valves controlling _____ to the system.

36. The pointer located at the 6 o'clock position on the pilot's attitude indicator will deviate toward an FM station when the FM control panel mode selector switch is in the HOME position and a usable signal is received. TRUE/FALSE.

37. The pilot controls the RESET functions of the copilot/gunner _____ light. He also controls the BRIGHT/DIM function of the copilot/gunner _____ lights.

38. Do not actuate the FIRE WARNING TEST switch more than _____ seconds.

39. Pulling the FIRE PULL handle will shut off _____ to the affected engine, deactivate the _____ and _____ circuits, close the _____ , and __ both fire extinguisher bottles.

40. If both FIRE PULL HANDLES are pulled out and the FIRE EXT switch is moved to _____ position, the bottle _____ discharge.

41. To actuate the canopy jettison system, rotate any handle _____ degrees and _____

42. The inertia reel will automatically lock the shoulder harness when the helicopter encounters an impact force in excess of _____ G deceleration.

43. For weight and balance purposes, the AH-1T (TOW) is classified as a class _____ helicopter.

44. The ECU and RAIN RMV switches shall be off for takeoff, landing or any time _____ is required.

45. The fuselage formation lights are powered by the _____ bus.

46. At temperatures of -25 degrees C and below, engine oil should be changed to MIL-L-_____.

47. Total fuel capacity is _____ U.S. gallons, of which _____ gallons are unusable.

48. The forward ground handling gear should be used when the helicopter is at a _____ and/or _____ of mid CG.

49. The duty cycle for the starter is: ___ seconds on, ___ minute(s) off, ___ seconds on, ___ minute(s) off, ___ seconds on, ___ minute(s) off.

50. The transmission torque limit in a dive is _____ %.

51. Power off, maximum transient rotor RPM is _____ %.

52. The maximum continuous ITT limit is _____ degrees C.

53. For engine starting, the 5 second limit is ___ to ___degrees C. The two second limit is _____ to _____ degrees C.

54. Without stores, maximum airspeed is _____ KIAS.

55. In a steady state autorotation, maximum airspeed is _____ KIAS.

56. The airspeed indicator is unreliable below _____ KIAS.

57. With wing stores, maximum airspeed is _____ KIAS.

58. Decrease airspeed _____ KIAS for each 1,000 feet of density altitude above ____ feet.

59. No airstarts or manual fuel control operation are permitted above _____ feet.

60. The most critical flight regime with the lateral CG at the most left station is a _____ KIAS _____ .

61. At a gross weight of 12,500 pounds, the aft CG limit is fuselage station _____ .

62. The effect of humidity on gas turbine engines is negligible. TRUE/FALSE.

63. If a starting attempt is discontinued, allow the engine to come to a _____ and then accomplish a _____ second _____ run.

64. A non-engaged engine is indicated by _____ slightly higher than the engaged engine and a near zero _____ indication.

65. The rain removal system shall not be utilized on a _____ windshield.

66. After takeoff, takeoff power should be maintained until a safe _____ airspeed is attained.

67. When making a slope landing, if mast bumping occurs, reposition _____ toward _____ .

68. Rapid application of _____ at or near flat pitch can result in a _____ or _____ overspeed.

69. Reducing collective rapidly and applying _____ cyclic can result in _____ overspeed.

70. Without the use of rotor brake on shutdown, winds of approximately _____ knots or above may cause the rotor to windmill indefinitely.

71. Carrier qualifications remain current for _____ months.

72. At gross weights of _____ pounds or lower,the aft ground handling gear may be used for moving the helicopter.

73. Aboard ship, in an emergency, the helicopter may be launched in _____ knot relative winds.

74. Aboard ship at night, the 180 degree position is _____ yards abeam.

75. Aboard ship, a _____ from the helicopter director is mandatory.

76. Full autorotative landings may be practiced by pilots _____ by _____ authority.

77. During autorotation, if the helicopter is only slightly out of balanced flight, the rate of descent will be increased by about _____feet per minute.

78. At average gross weights, best glide speed is approximately _____ knots.

79. The two basic types of formations are _____ and _____ .

80. The parade position for echelon, fingertip and diamond is on a _____ degree bearing either side of lead axis with _____feet of step up.

81. A marked increase in airframe vibration and, possibly, control feedback is an indication of impending _____ .

82. During left rolling maneuvers or high power dives, _____ , _____ , and ____ increases occur.

83. AH-1T (TOW) helicopters have a tendency to roll to the _____ when forward cyclic is used to initiate a lower than ____ G maneuver in forward flight.

84. Mast bumping generally occurs at the _____ of the operating _____ .

85. During autorotation transient rotor rpms of _____ to _____ % are allowed up to _____ seconds.

86. List the four factors which affect power-off rotor rpm.

1.
2.
3.
4.

87. If an engine fails during takeoff, _____ , _____ , _____ , and _____ will determine if flight can be maintained.

NEW 88. With a dual hydraulic failure, cyclic feedback may be encountered at airspeeds below _____ KIAS.

89. A shear pin is incorporated in the _____ linkage connection to the collective linkage.

90. For most gross weights, it is unlikely that the AH-1T (TOW) can achieve a _____ flight condition following loss of tail rotor thrust.

91. In an ACTUAL emergency, it is not necessary to wait for Ng to stabilize at engine idle before switching to manual fuel. TRUE/FALSE.

92. Loss of DC power from the _____ to the main inverter will result in _____ switch over to the standby inverter.

93. Total loss of electrical power will cause the loss of all engine and component instruments, indicators, and gages except _____ tachometers.

94. The canopy doors may be opened in flight below _____ KIAS.

95. Avoid helicopter operation with dual fuel boost pump failure above _____ feet.

96. Under certain conditions, airspeed in excess of _____ KIAS may be necessary to land under single engine conditions.

97. Do not operate the engine in excess of _____ % Ng until engine and combining gearbox oil temperature reach + _____ degrees C.

98. When the microphone at the right crew station is keyed, it connects the right station to the _____ mike circuit.

99. When testing the radar altimeter, a reading of _____ plus or minus _____ feet will be indicated if the system is functioning properly.

NEW NEW NEW NEW NEW NEW NEW NEW NEW NEW NEW

100. The azimuth range of the turret system is _____ degrees, the gun may be depressed a maximum of _____ degrees.

101. If the mode switch on the NARCADS panel is placed in ALL, the _____ function is disabled.

102. The smoke grenade system is energized with the master arm switch in STBY. TRUE/FALSE.

103. The PILOT OVERRIDE switch electrically bypasses the _____ switch.

104. The gunner ACQ switch is located on the _____ .

105. The TOW missile programmer programs the firing sequence for a period of _____ .

106. _____ TOW missiles may be carried on the _____ wing stations.

107. The TOW missile launch motor is expended before the _____ .

108. The TSU has an angular field of view of _____ degrees in low mag and ____ degrees in high mag.

109. The ready flag on the PSI means _____ .

110. The Weapon Control switch has to be in _____ to operate the TMS.

111. Reinstallation of the upper TMLs will require that the system be _____ before use.

112. When in PILOT OVERRIDE mode, the gunner utilizes the _____ and _____ switches to direct and fire the turret utilizing the GHS.

SECTION XI — PERFORMANCE DATA

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INTRODUCTION.

The charts presented on the following pages are provided to aid in preflight and in-flight planning. Through the use of the charts, the pilot is able to select the best power setting, altitude, and airspeed to be used to obtain optimum performance for the mission being flown. The charts are presented in graphic or profile form. Charts are based on flight-test data, estimated data or calculated data as indicated on the chart.

PART 1 — STANDARD DATA

AIRSPEED CALIBRATION CHART.

The airspeed calibration chart (figure 11-1) converts calibrated airspeed to indicated airspeed and vice versa. Calibrated airspeed (KCAS) is indicated airspeed (KIAS) as read from the airspeed indicator corrected for instrument error, plus the installation correction. Corrections for cruise, climb, and autorotation are shown.

EXAMPLE: Convert 131 KCAS to equivalent KIAS for a cruise condition.

Solution:

a. Enter figure 11-1 at 131 KCAS. Move right to cruise line.

b. Drop down and read 136.8 KIAS.

PRESSURE ALTITUDE.

Pressure altitude is the altitude indicated on the altimeter when the barometric scale is set on 29.92. It is the height above the theoretical plane at which the air pressure is equal to 29.92 inches of mercury.

DENSITY ALTITUDE.

Density altitude is an expression of the density of the air in terms of height above sea level; hence, the less dense the air, the higher the density altitude. For standard conditions of temperature and pressure, density altitude is the same as pressure altitude. As temperature increases above standard for any altitude, the density altitude will

also increase to values higher than pressure altitude. Figure 11-2 expresses density altitude as a function of pressure altitude and temperature.

The chart also includes the inverse of the square root of the density ratio ($1/\sqrt{\sigma}$), which is used to calculate TAS by the relation:

$$TAS = CAS \times 1/\sqrt{\sigma}$$

EXAMPLE: If the ambient temperature is 0°C (standard day) and the pressure altitude is 4000 feet, find the density altitude, $1/\sqrt{\sigma}$, and true airspeed for 131 KCAS.

Solution:

a. Enter the bottom of the chart (figure 11-2) at +0°C.

b. Move vertically upward to the 4000 feet pressure altitude line.

c. From this point, move horizontally to the left and read a density altitude of 3150 feet and move horizontally to the right and read $1/\sqrt{\sigma}$ equals 1.047.

d. True airspeed = KCAS x $1/\sqrt{\sigma}$ = 131 x 1.047 = 137.2 KTAS

SHAFT HORSEPOWER VERSUS TORQUE.

The shaft horsepower versus torque chart (figure 11-3) provides a means of converting torque to shaft horsepower, and vice versa, for 100 percent rotor rpm.

EXAMPLE: Determine the shaft horsepower equivalent for a 37 percent torque (%Q) during single engine operation, 100 percent rotor rpm.

Solution:

a. Enter figure 11-3 at 37%Q single engine torque. Move up and intersect the baseline.

b. Move left, read 750 single engine shaft horsepower.

TORQUE AVAILABLE.

Outside air temperature and pressure altitude change the capability of the turboshaft engine to produce power at the rated interturbine temperatures. Figures 11-4 and 11-5 shows the power available at the intermediate and the maximum continuous power ratings respectively for both twin and single engine operation.

The torque output capability of the engine can exceed the structural limits of the transmision under certain conditions during twin engine operation. Because of this, the restriction on twin engine operation is (transmission torque) 100%Q for 5 minutes operation, and 84.9%Q for continuous operation. The restrictions on single engine operation are due to engine mechanical limitations, therefore 53.1%Q for 30 minutes and 45.2%Q for continuous operation shall not be exceeded during single engine operation.

EXAMPLE: At 4000 feet, +7.1°C (standard day) find the maximum continuous power available during both twin and single engine operation.

Solution:

a. Figure 11-5 shows maximum continuous power available. Enter the left scale at 4000 feet pressure altitude.

b. Move right and interpolate for +7.1°C OAT.

c. For twin engine torque move up and read 70%Q twin engine torque available, or for single engine torque move down and read 35%Q single engine torque available.

FUEL FLOW.

The fuel flow chart (figure 11-6) shows the fuel flow for a given altitude and power setting for both twin and single engine operation at 0°C outside air temperature.

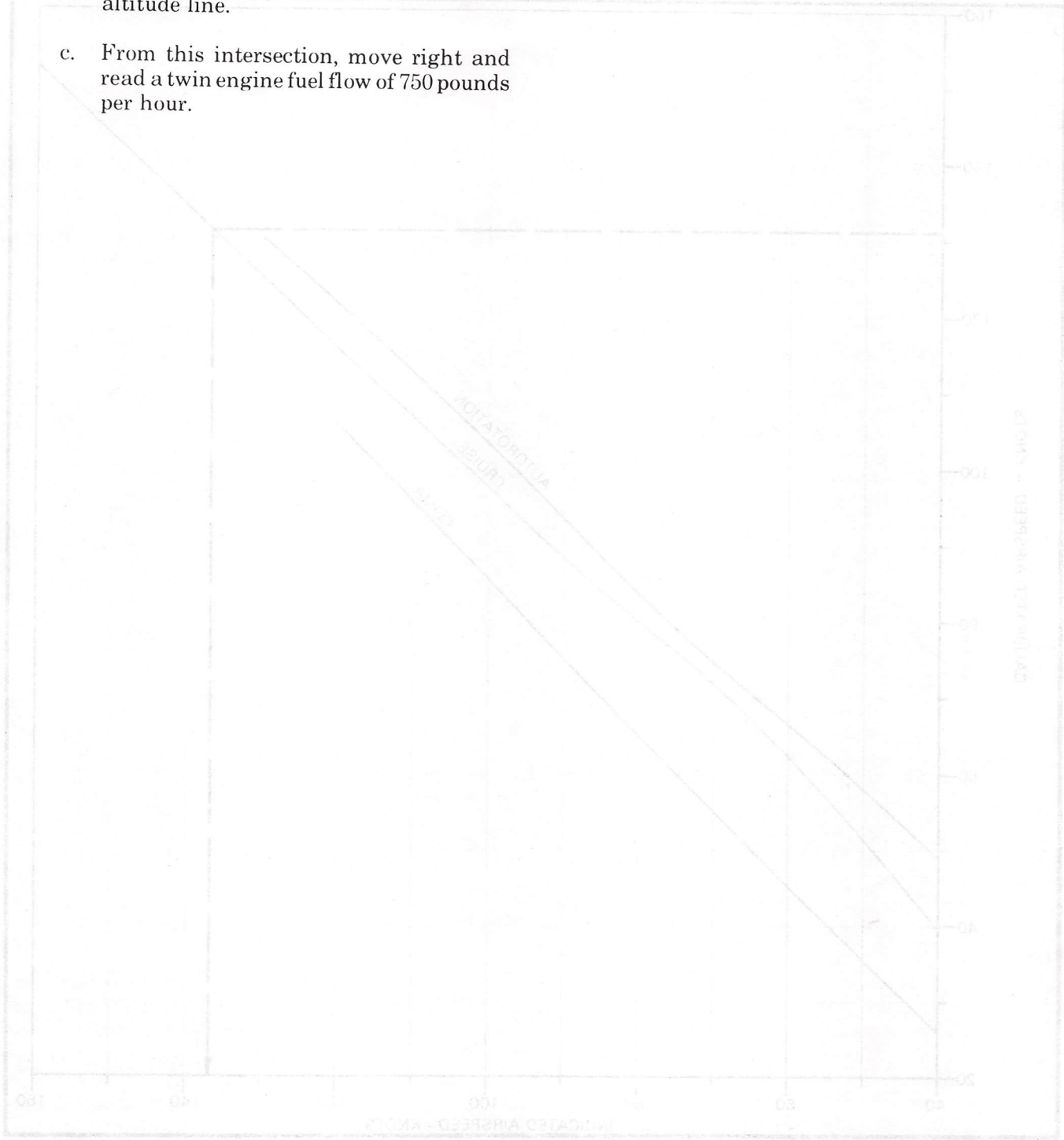
EXAMPLE: Find the fuel consumption of the helicopter at a torquemeter setting of 55%Q for 4000 feet, 0°C OAT, twin engine operation.

Solution:

a. Enter the top torque scale of the chart (figure 11-6) at 55 percent indicated torque.

b. Move down to the 4000 feet pressure altitude line.

c. From this intersection, move right and read a twin engine fuel flow of 750 pounds per hour.



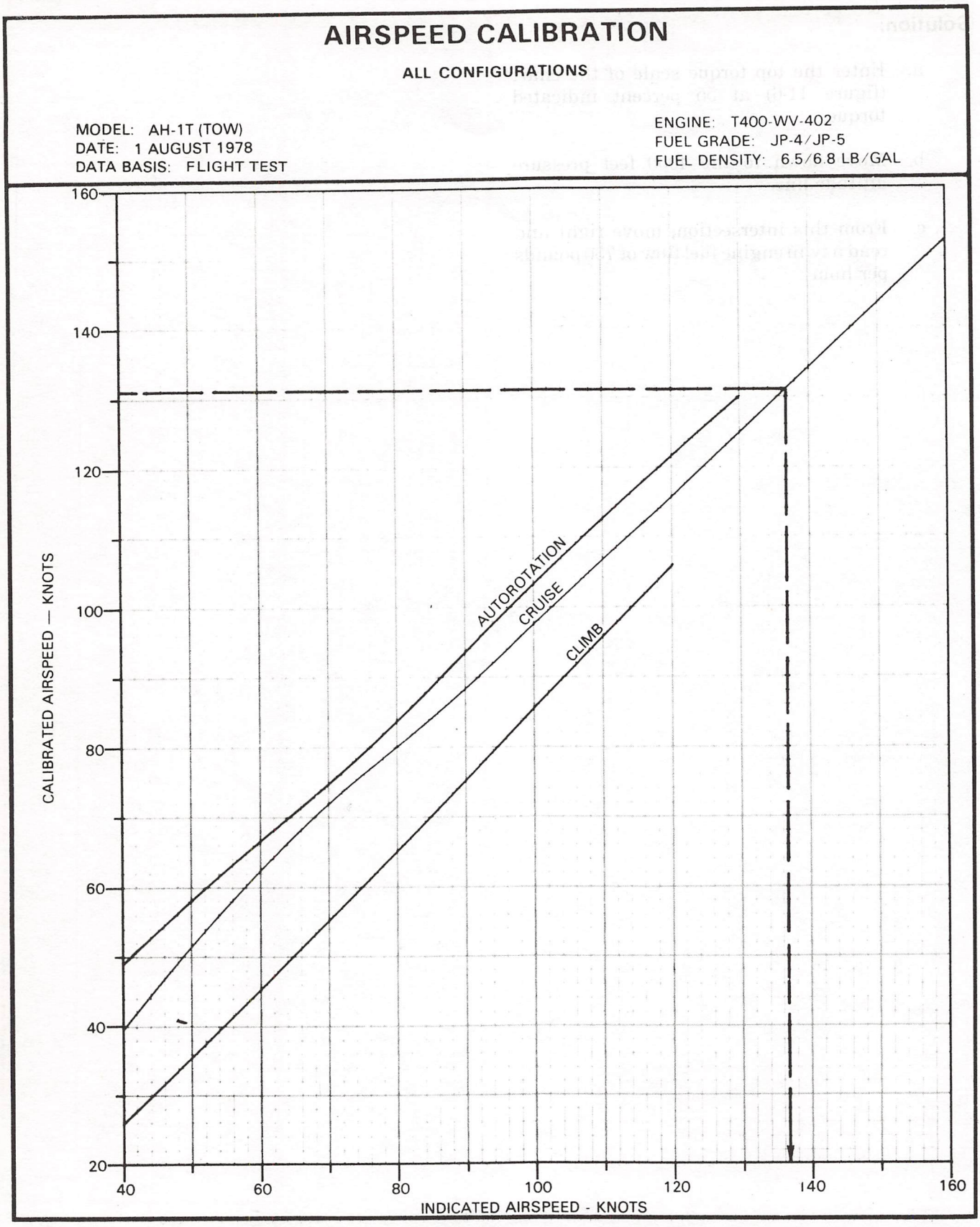


Figure 11-1. Airspeed calibration chart

DENSITY ALTITUDE/TEMPERATURE CONVERSION

DATA BASIS: CALCULATED DATA

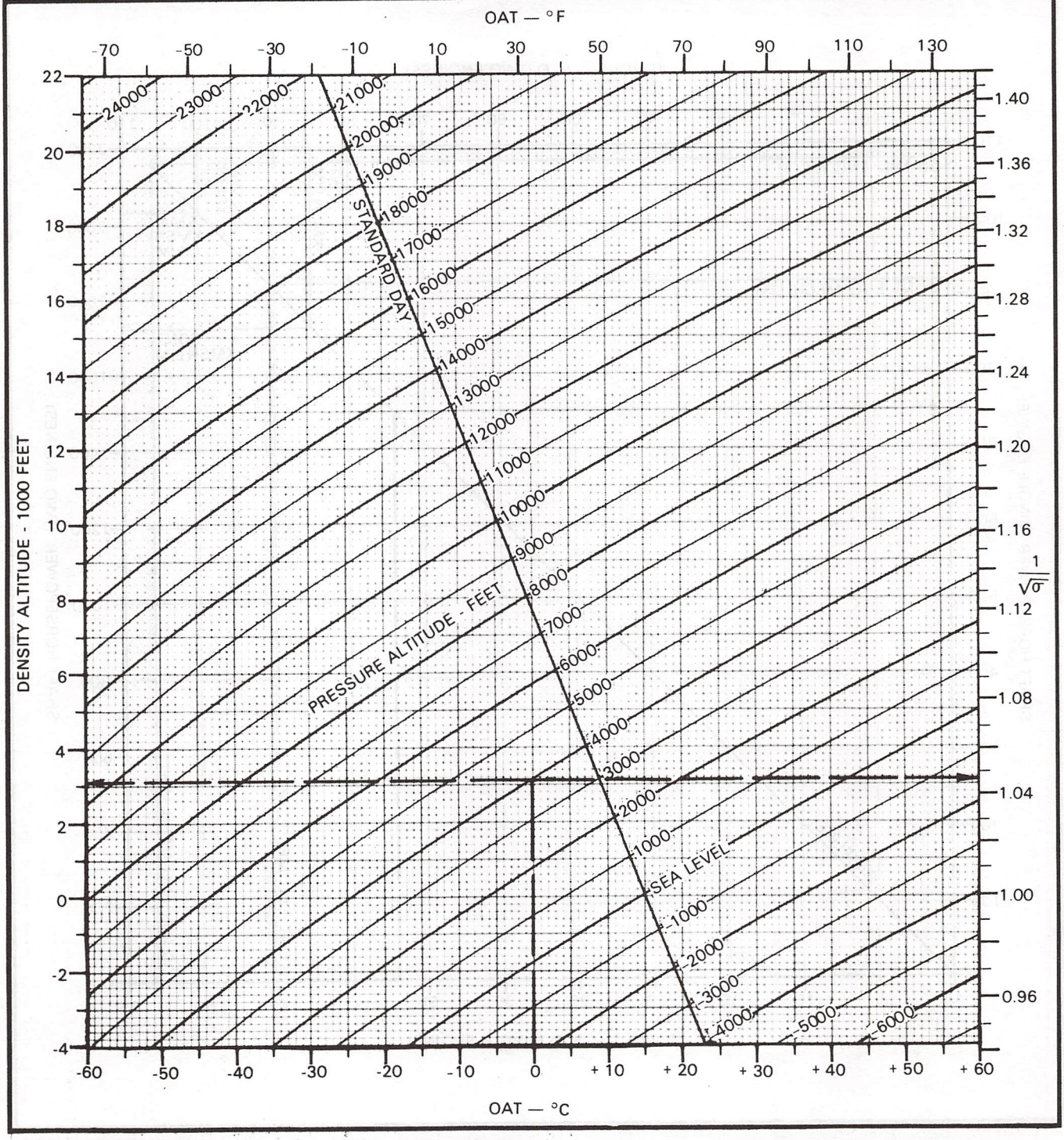


Figure 11-2. Density altitude/temperature conversion chart

SHAFT HORSEPOWER VS TORQUE

100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

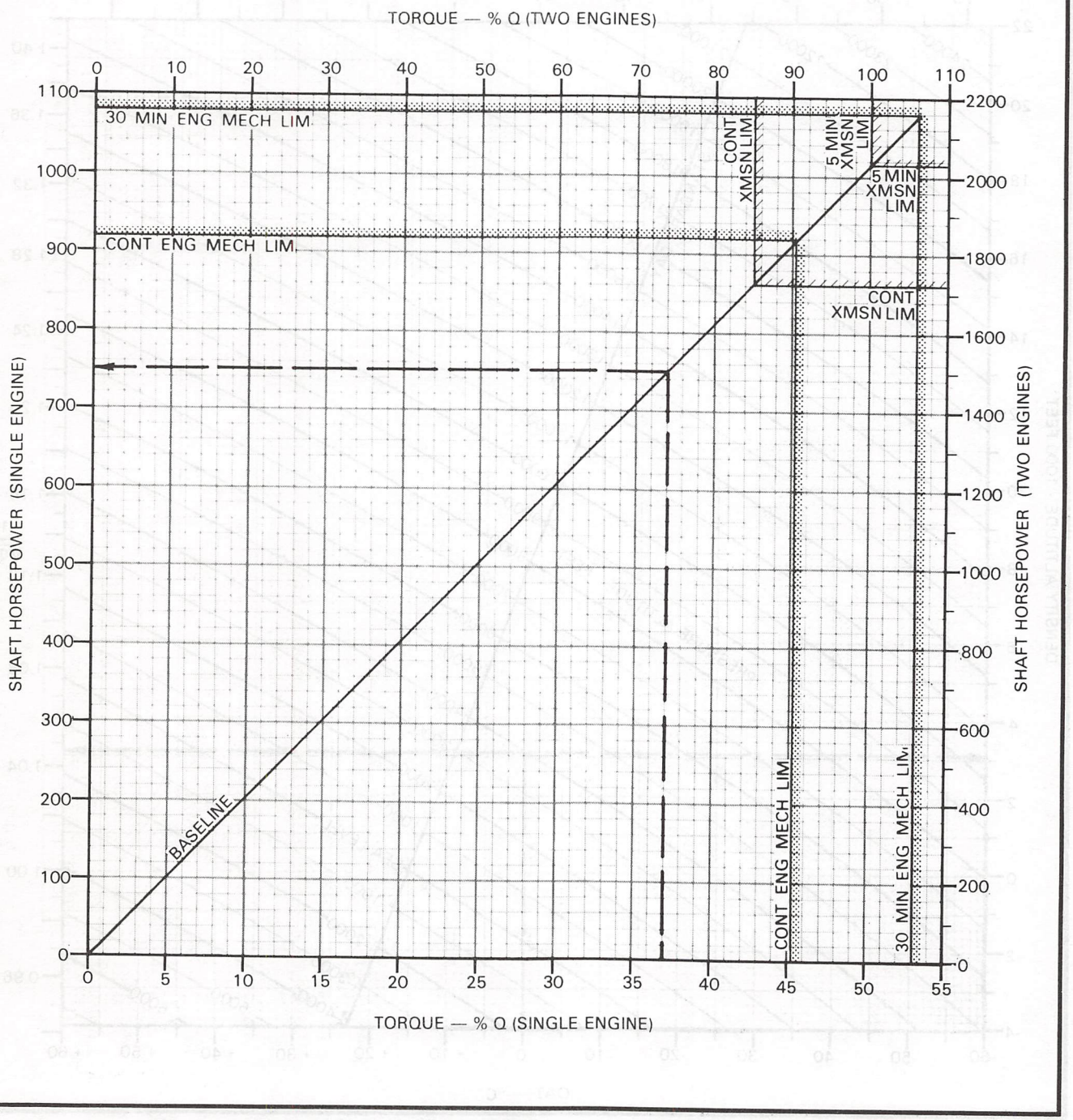


Figure 11-3. Shaft horsepower vs torque chart

MAXIMUM TORQUE AVAILABLE
(30 MINUTE OPERATION)

INTERMEDIATE RATED POWER
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

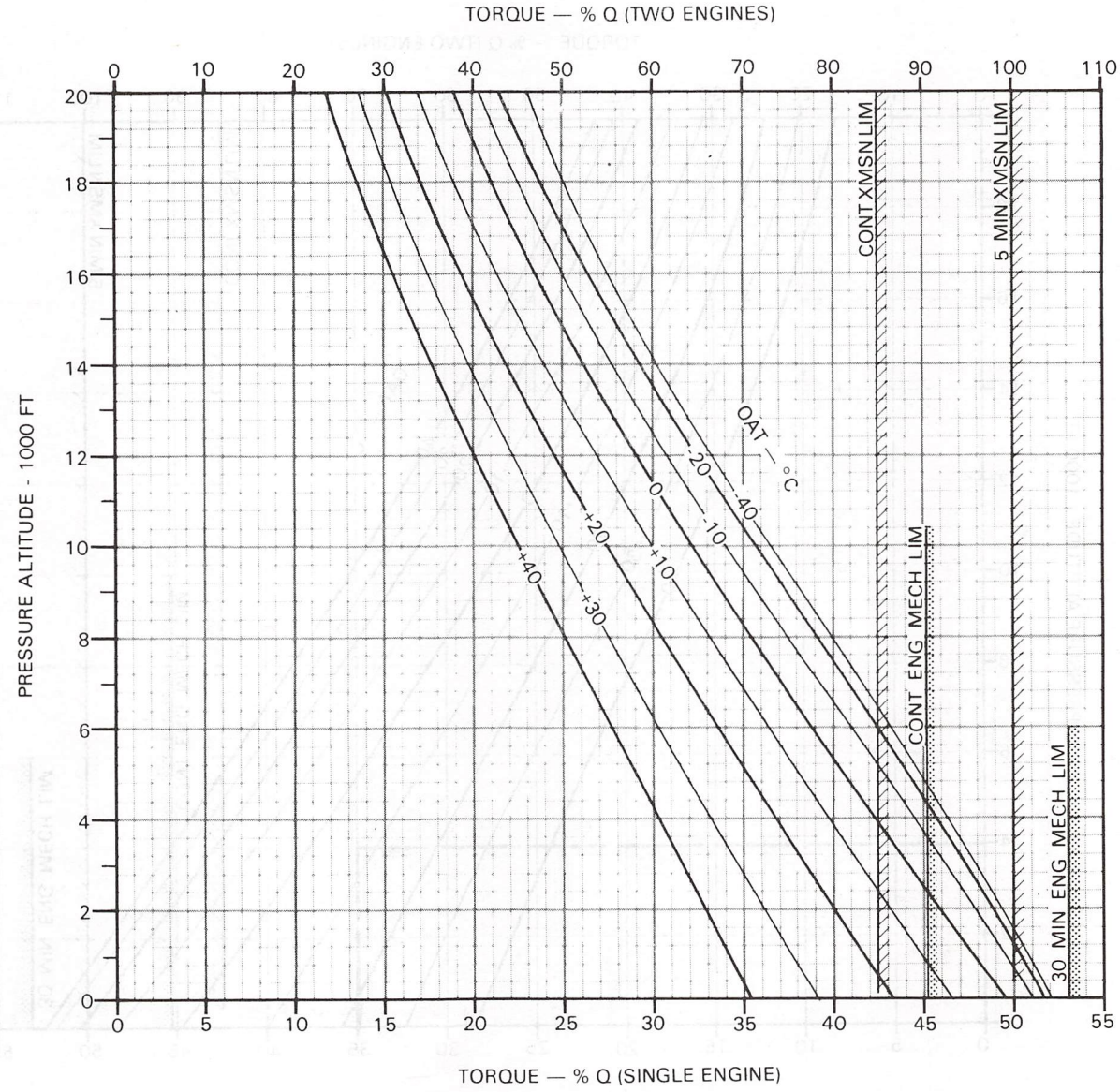


Figure 11-4. Maximum torque available (30 minute operation) chart

CONTINUOUS TORQUE AVAILABLE

MAXIMUM CONTINUOUS POWER

100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

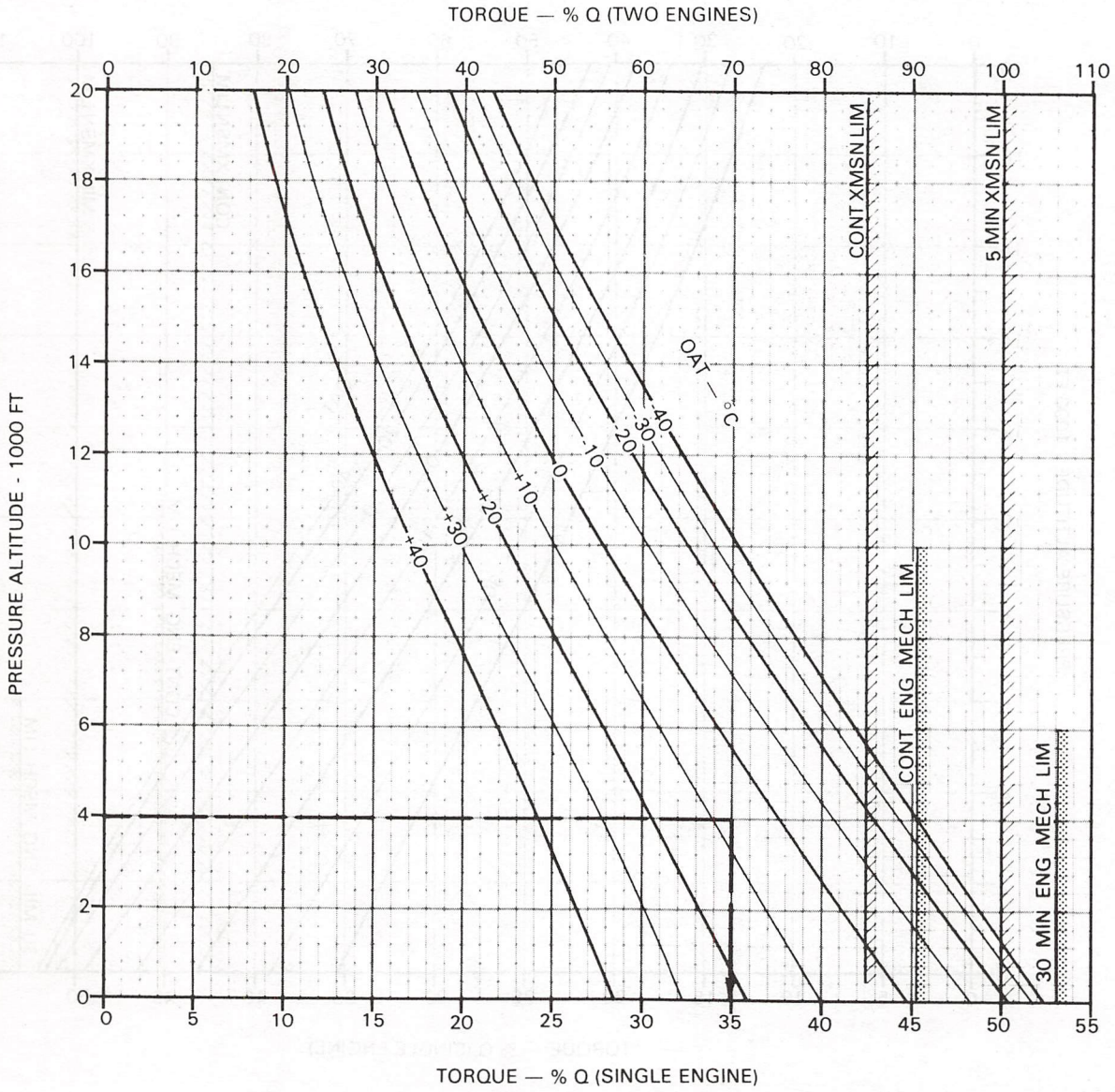


Figure 11-5. Continuous torque available chart

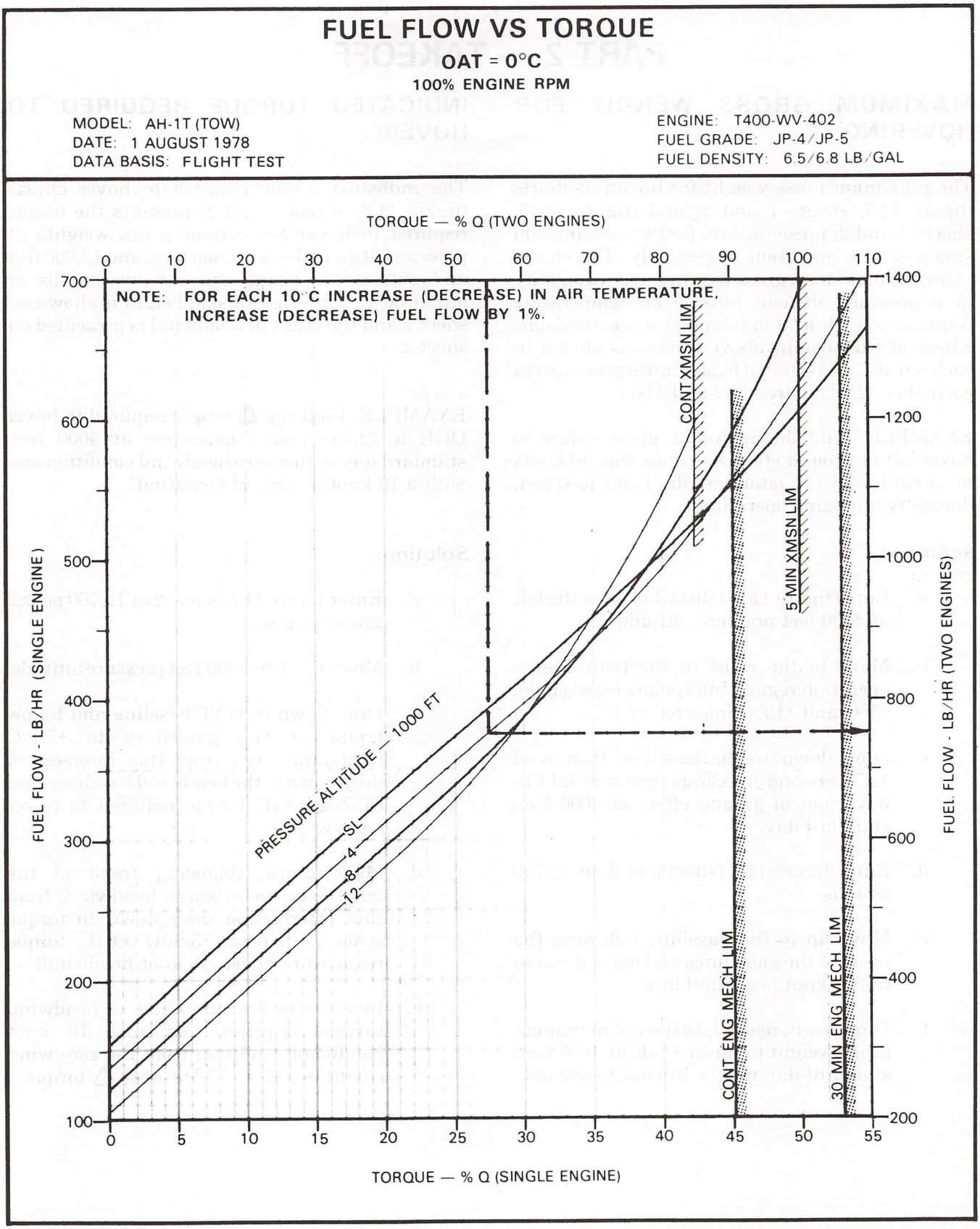


Figure 11-6. Fuel flow vs torque chart

PART 2 — TAKEOFF

MAXIMUM GROSS WEIGHT FOR HOVERING.

The maximum gross weight for hovering charts (figure 11-7, sheets 1 and 2) and (figure 11-17, sheets 1 and 2) presents data for twin engine and single engine operation respectively. The charts show the maximum gross weight hover capability at a pressure altitude, outside air temperature combination while at maximum torque available. Effect of skid height above ground is shown in each sheet 1, and effect of headwind is presented in each sheet 2; of figures 11-7 and 11-17.

EXAMPLE: Find the maximum gross weight to hover out of ground effect with zero and 10 knots headwind at +7.1°C (standard day) and 4000 feet, during twin engine operation.

Solution:

a. Enter figure 11-7, (sheet 1 of 2) on the left at 4000 feet pressure altitude.

b. Move to the right to the twin engine operation region. Interpolate between the +5°C and +10°C lines for +7.1°C.

c. Drop down to the baseline, then read 12,700 pound maximum gross weight to hover out of ground effect at 4000 feet, standard day.

d. Enter figure 11-7 (sheet 2 of 2) at 12,700 pounds.

e. Move up to the baseline, following the trend of the guidelines and move down to the 10 knot headwind line.

f. Drop down, read 13,320 pound maximum gross weight to hover OGE at 4000 feet, standard day with a 10 knot headwind.

INDICATED TORQUE REQUIRED TO HOVER.

The indicated torque required to hover charts (figure 11-8, sheets 1 and 2) presents the torque required to hover for various gross weights at pressure altitudes between sea level and 12,000 feet and outside air temperatures between plus or minus 50°C. The effect of skid height is shown on sheet 1 and the effect of headwind is presented on sheet 2.

EXAMPLE: Find the Δ torque required to hover OGE a 12,700 pound helicopter at 4000 feet, standard day with a zero headwind condition and with a 10 knot headwind condition.

Solution:

a. Enter figure 11-8, sheet 2 at 12,700 pound gross weight.

b. Move right to 4000 feet pressure altitude.

c. Drop down to OAT baseline and follow trend of the guidelines to +7.1°C (standard day), from this intersection drop down to the headwind baseline, read 81.5%Q OGE torque required to hover (zero wind).

d. Move down, following trend of the guidelines, to 10 knots headwind, from this intersection drop down to torque scale and read 75.5%Q OGE torque required to hover (10 knot headwind).

e. In order to find the effect of headwind torque required, subtract 10 knot headwind condition from the zero wind condition (81.5 - 75.5) = 6%Q Δ torque.

MAXIMUM GROSS WEIGHT FOR HOVERING

(EFFECT OF SKID HEIGHT ABOVE GROUND)

TWO ENGINE OPERATION AT INTERMEDIATE RATED POWER

ZERO WIND CONDITION

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

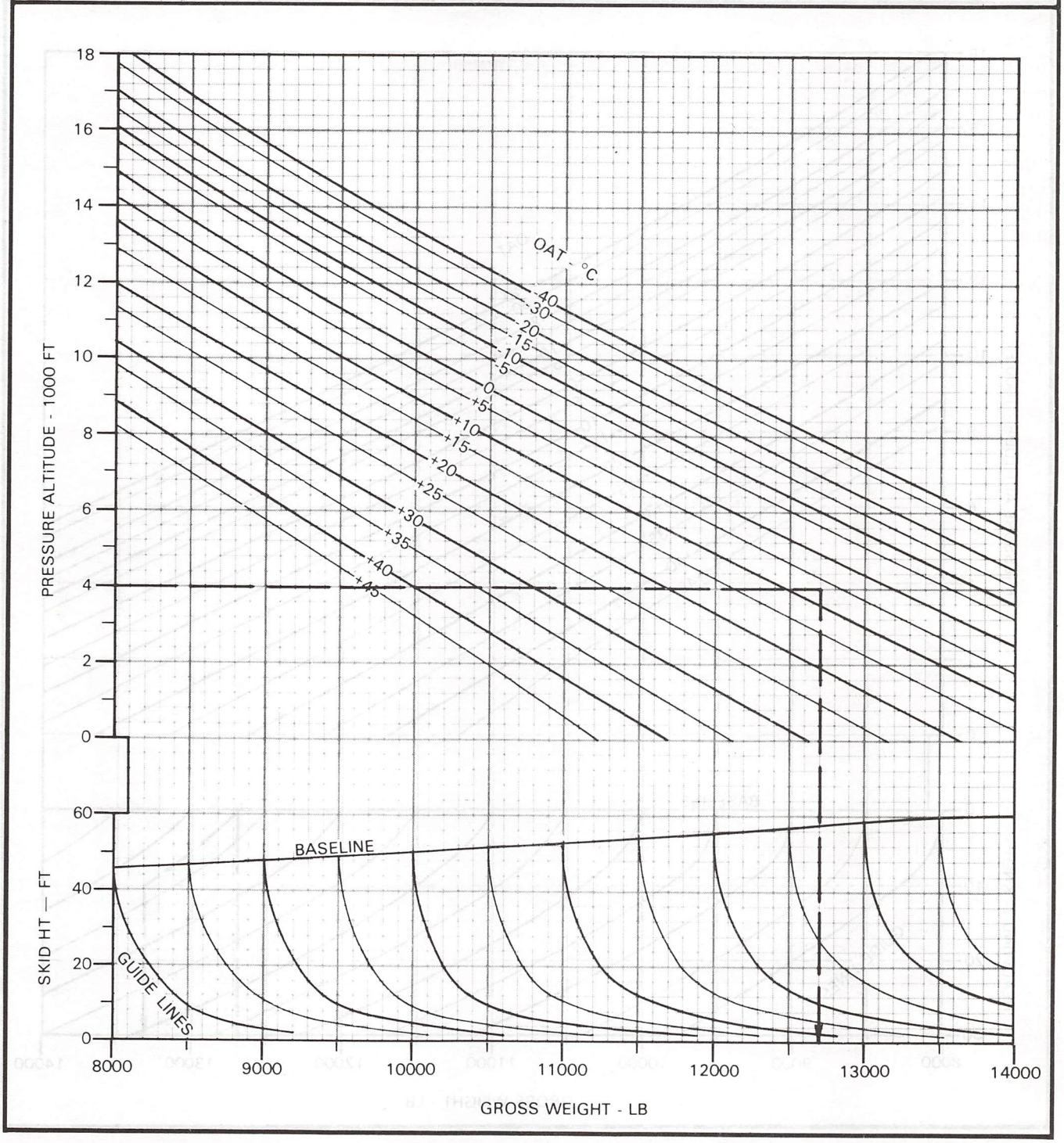


Figure 11-7. Maximum gross weight for hovering chart (Sheet 1 of 2)

MAXIMUM GROSS WEIGHT FOR HOVERING
(EFFECT OF HEADWIND)

TWO ENGINE OPERATION AT INTERMEDIATE RATED POWER
OUT OF GROUND EFFECT
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

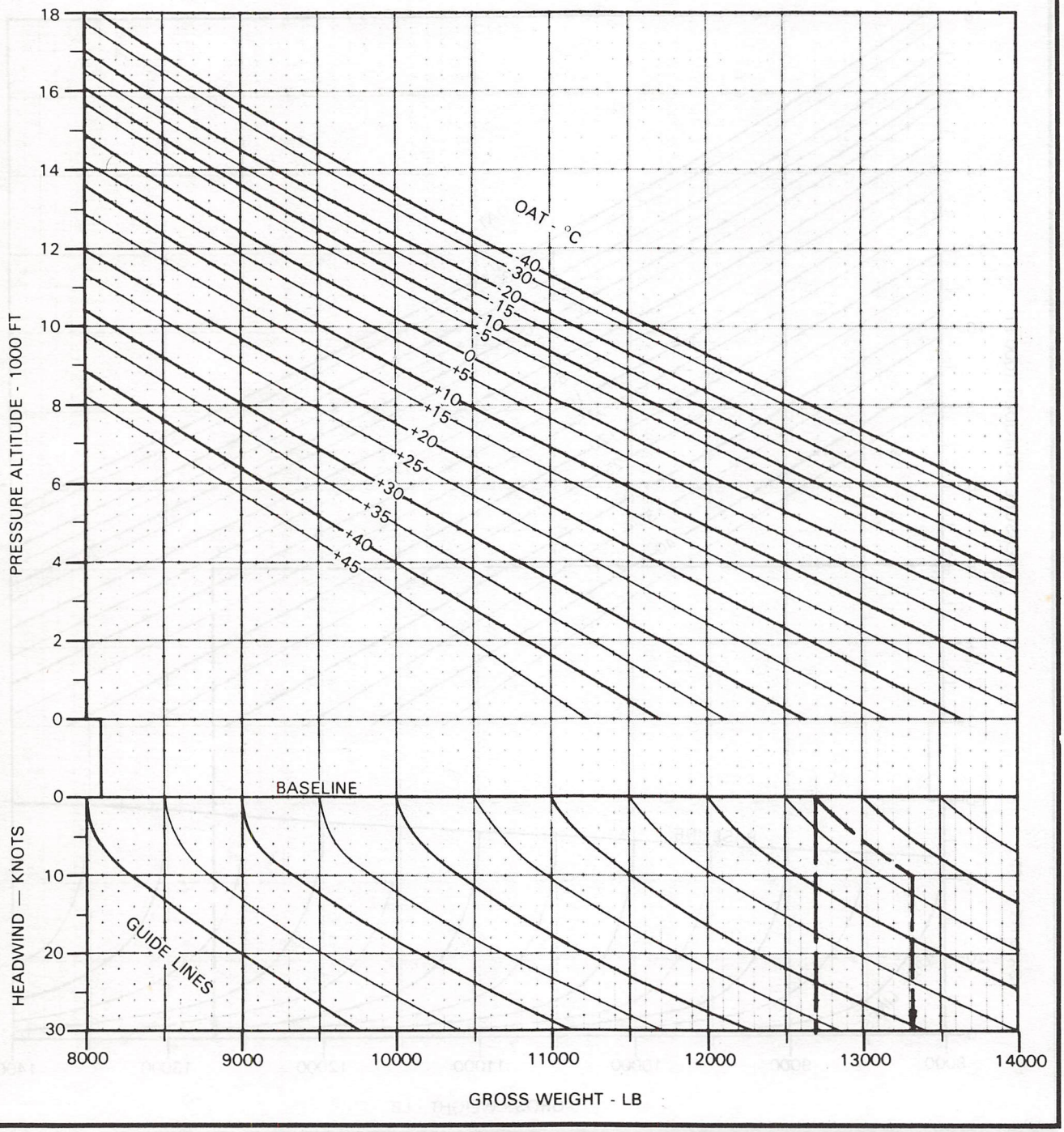


Figure 11-7. Maximum gross weight for hovering chart (Sheet 2 of 2)

INDICATED TORQUE REQUIRED TO HOVER
(EFFECT OF SKID HEIGHT ABOVE GROUND)
ZERO WIND CONDITION

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

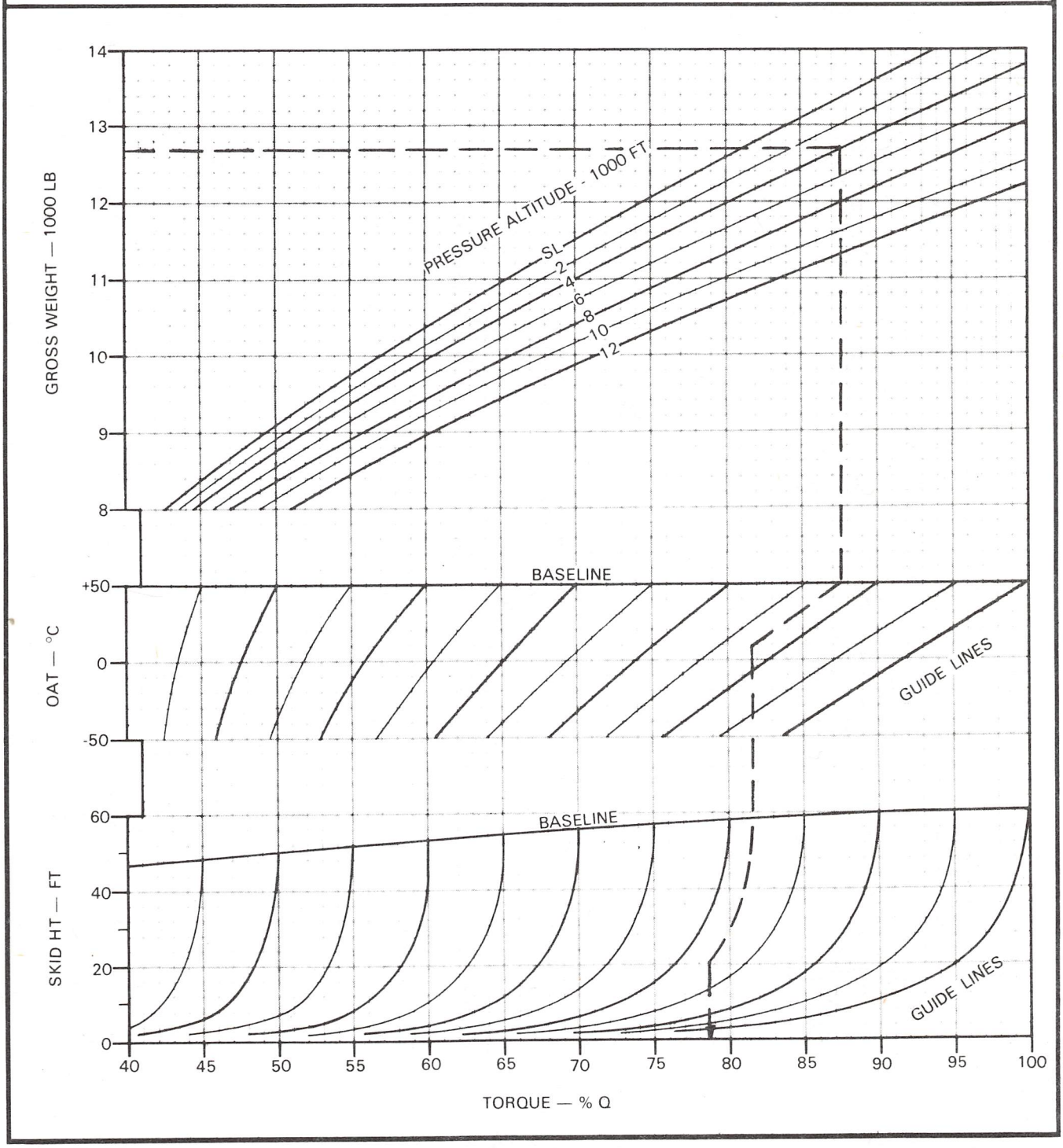


Figure 11-8. Indicated torque required to hover chart (Sheet 1 of 2)

INDICATED TORQUE REQUIRED TO HOVER
(EFFECT OF HEADWIND)
OUT OF GROUND EFFECT

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

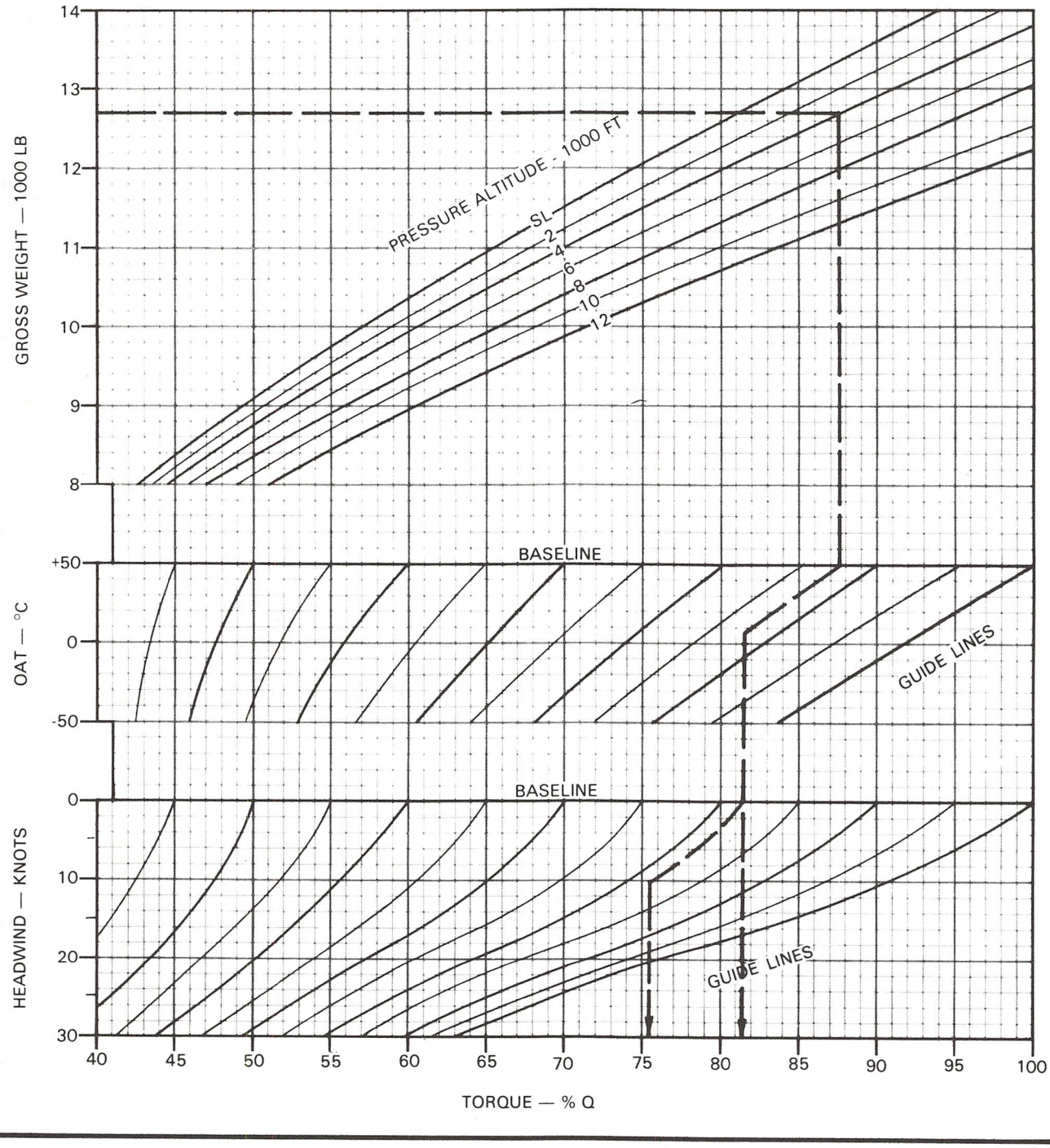


Figure 11-8. Indicated torque required to hover chart (Sheet 2 of 2)

PART 3 — CLIMB

CLIMB PERFORMANCE.

The climb performance charts (figure 11-9, twin engine operation; and figure 11-18, single engine operation) show the time, distance, and fuel to climb from sea level to 12,000 feet. Thus, when climbing from any one altitude to another, the climb performance is the difference between a climb from sea level to the initial altitude, and a climb from sea level to the final altitude.

These charts do not include the fuel used for warmup and takeoff, which is 26 pounds (two minutes at maximum continuous power). This amount must be added to the climb fuel to determine the total fuel required to reach cruise altitude from an engine-off pretakeoff condition.

EXAMPLE: Find the time, distance, and fuel required to climb from 4000 feet, +7.1°C (standard day) to 10,000 feet, -4.8°C (standard day), with a gross weight of 12,700 pounds, twin engine operation.

Solution:

a. Enter the gross weight scale of figure 11-9 at 12,700 pounds. Proceed horizontally to the right and intersect the 4000 feet pressure-altitude curve. Move vertically upward and interpolate for +7.1°C OAT. Move horizontally to the time scale and read 1.5 minutes.

b. Enter the gross weight scale of figure 11-9 again at 12,700 pounds. Proceed horizontally to the right and intersect the 10,000 feet pressure altitude curve. Move vertically upward and interpolate for -4.8°C OAT. Move horizontally to the time scale and read 5.9 minutes.

c. To obtain the time to climb from 4000 feet to 10,000 feet, subtract the time to climb from sea level to 4000 feet from the time to climb from sea level to 10,000 feet. For this example, the time to climb would be (5.9 - 1.5) = 4.4 minutes.

d. Using the same procedure as above, distance to climb from 4000 to 10,000 feet would be (7.5 - 1.2) = 6.3 nautical miles; climb fuel from 4000 to 10,000 feet would be (95 - 30) = 65 pounds.

e. If the climb began with a warmup and takeoff, the climb fuel would include this fuel allowance, or (65 + 26) = 91 pounds.

SERVICE CEILING.

There are two service ceiling charts shown. One, figure 11-23, is for single engine operation at intermediate rated power; the other, figure 11-10, is for twin engine operation at maximum continuous power. The single engine service ceiling chart is for emergency situations where one engine is inoperative and for planning purposes wherein the pilot wishes to pick a route that does not rely on both engines operating continuously.

EXAMPLE: Find the -5°C service ceiling for a 13,000 pounds gross weight helicopter at twin engine operation, maximum continuous power.

Solution:

a. Since the helicopter is operating at twin engine maximum continuous power, turn to figure 11-10.

b. Enter figure 11-10 at 13,000 pounds gross weight. Move straight upward and intersect the -5°C line.

c. Move horizontally to the left and read a service ceiling of 12,000 feet.

CLIMB PERFORMANCE

TWO ENGINE OPERATION AT INTERMEDIATE RATED POWER

ALL CONFIGURATIONS

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

100% ENGINE RPM

65 KIAS

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

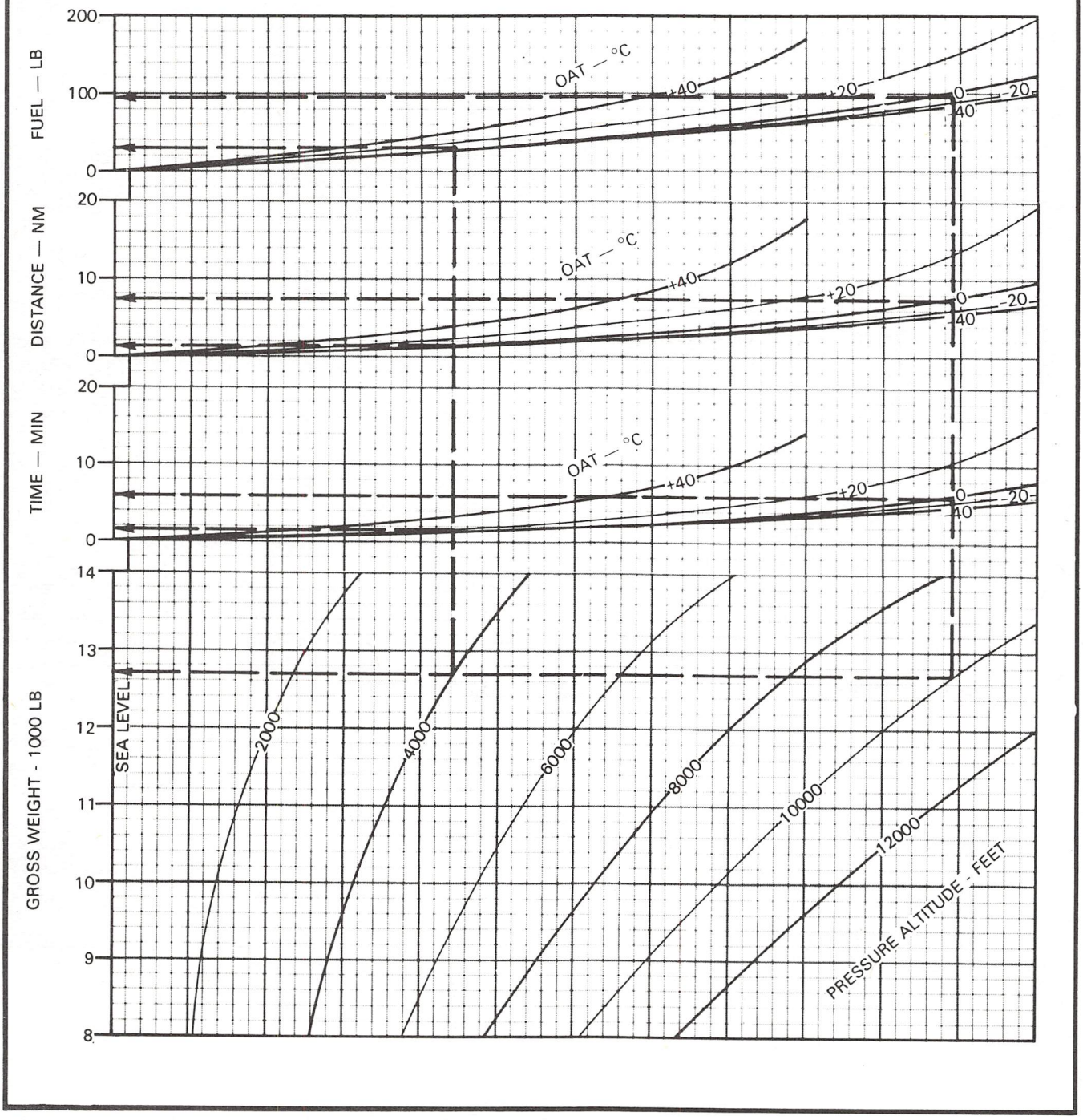


Figure 11-9. Climb performance chart

SERVICE CEILING

TWO ENGINE OPERATION AT MAXIMUM CONTINUOUS POWER

ALL CONFIGURATIONS

100% ENGINE RPM

65 KIAS

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

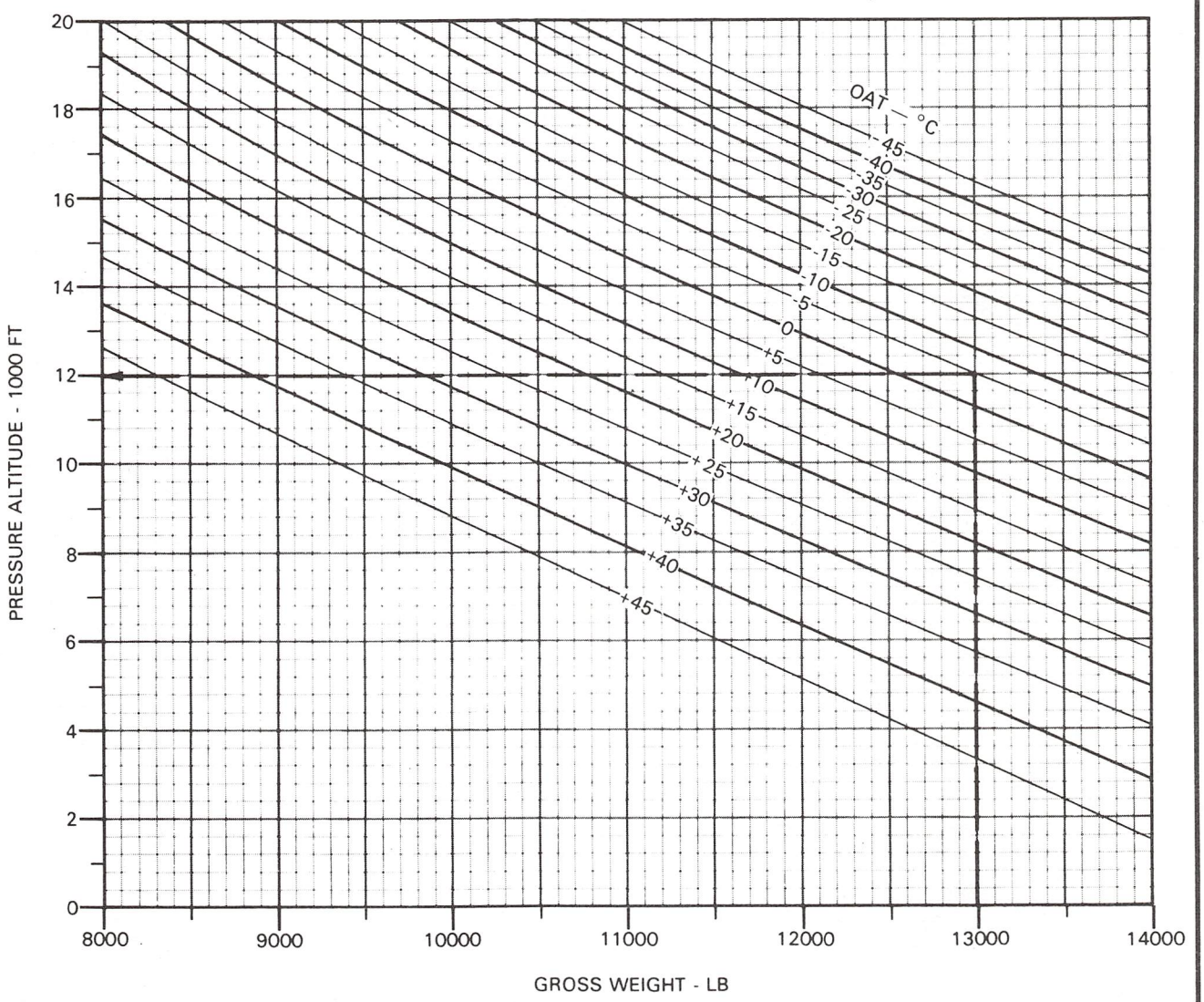


Figure 11-10. Service ceiling chart

PART 4 — RANGE

BEST RANGE.

The best range charts (figure 11-11, sheets 1 thru 8, 8 TOW missile configuration, twin engine operation; figure 11-12, sheets 1 thru 8, clean configuration, twin engine operation; figure 11-19, sheets 1 thru 4, 8 TOW missile configuration, single engine operation and figure 11-20, sheets 1 thru 4, clean configuration, single engine operation) show fuel flow, calibrated airspeed, torque required and unit range as a function of gross weight and pressure altitudes for temperature ranges of -10°C and colder, between -10°C and +10°C, between +10°C and +25°C, and +25°C and hotter. Total fuel loading must be known in order to determine maximum range.

EXAMPLE: Determine the torque required, fuel flow, airspeed, unit range and the maximum range of a 12,700 pound helicopter, 8 TOW missile configuration and twin engine operation at a pressure altitude of 4000 feet +7.1°C (standard day). Total fuel loading is 2025 pounds.

Solution:

a. Enter figure 11-11, sheets 3 and 4 at 12,700 pounds gross weight.

b. Move up to 4000 feet pressure altitude lines, and read:

   1. Torque required = 66%Q,

   2. Fuel flow = 842 lb/hr,

   3. Airspeed = 122 KCAS

   4. Unit range = .1517 n mi/lb fuel.

c. To determine maximum range, multiply the fuel loading by the unit range (2025 x .1517 = 307 n mi).

RANGE.

The twin engine range charts (figure 11-13, sheets 1 thru 12) and the single engine range charts (figure 11-21, sheets 1 thru 12) shows performance data for both 8 TOW missile and clean configurations. Charts present torque required and fuel flow (in a tabulated format) and calibrated airspeed and unit range (in graphical formats) as a function of gross weight and pressure altitude for temperature ranges of -10°C and colder, between -10°C and +10°C, between +10°C and +25°C, and +25°C and hotter. Total fuel loading must be known in order to determine range. Since figure 11-13 and figure 11-20 are identical in format, only one example will be shown.

EXAMPLE: Determine range and endurance at cruise condition, MCP, twin engine operation of a 12,700 pound helicopter at a pressure altitude of 4000 feet, +7.1°C (standard day), with a fuel loading of 2025 pounds for 8 TOW missile configuration.

Solution:

a. Enter figure 11-13 sheet 4 at 12,700 pound gross weight. Move up to 4000 feet lines and read:

   8 TOW missile configuration = 131 KCAS.

b. Convert calibrated airspeed to true airspeed by using the density altitude chart (figure 11-2 example).

   8 TOW missile configuration = 137.2 KTAS.

c. Enter table at top of figure 11-13 sheet 4 at 4000 feet pressure altitude and read 934 lb/hr fuel flow.

d. Divide fuel loading by fuel flow to determine endurance (2025 ÷ 934) = 2.17 hours.

e. Multiply KTAS times endurance to obtain range.

   8 TOW missile configuration (137.2 x 2.17) = 297.7 n mi.

TIME AND RANGE VS FUEL.

The time and range vs fuel chart (figure 11-14) shows the enroute time and the distance that the helicopter can cover while in level cruise with calm winds. The only information needed is the cruise fuel, the fuel flow and the cruise true airspeed.

EXAMPLE: Find the time enroute and range covered while the helicopter consumes 2025 pounds of fuel at a rate of 842 pounds per hour while cruising at a true airspeed of 122 KTAS.

Solution:

a. Enter figure 11-14 on the upper left at 2025 pounds of fuel. Move horizontally and interpolate for 842 pounds per hour fuel flow.

b. Drop to the time scale and read 150 minutes enroute time.

c. Continue to drop and interpolate between the true airspeed lines to 122 KTAS. Then project left and read 305 nautical miles range.

BEST RANGE

OAT COLDER THAN -10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

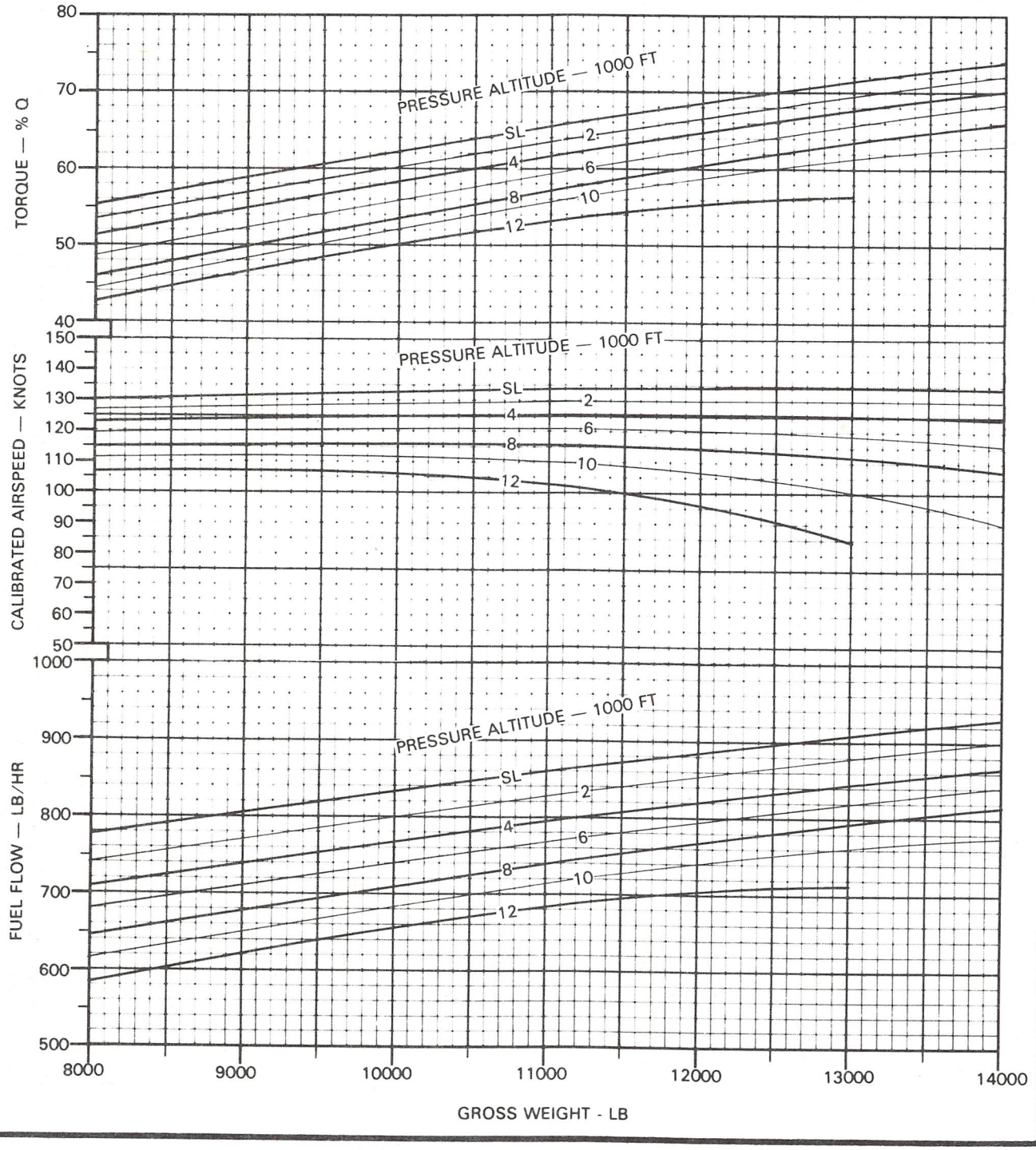


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 1 of 8)

BEST RANGE

OAT COLDER THAN -10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

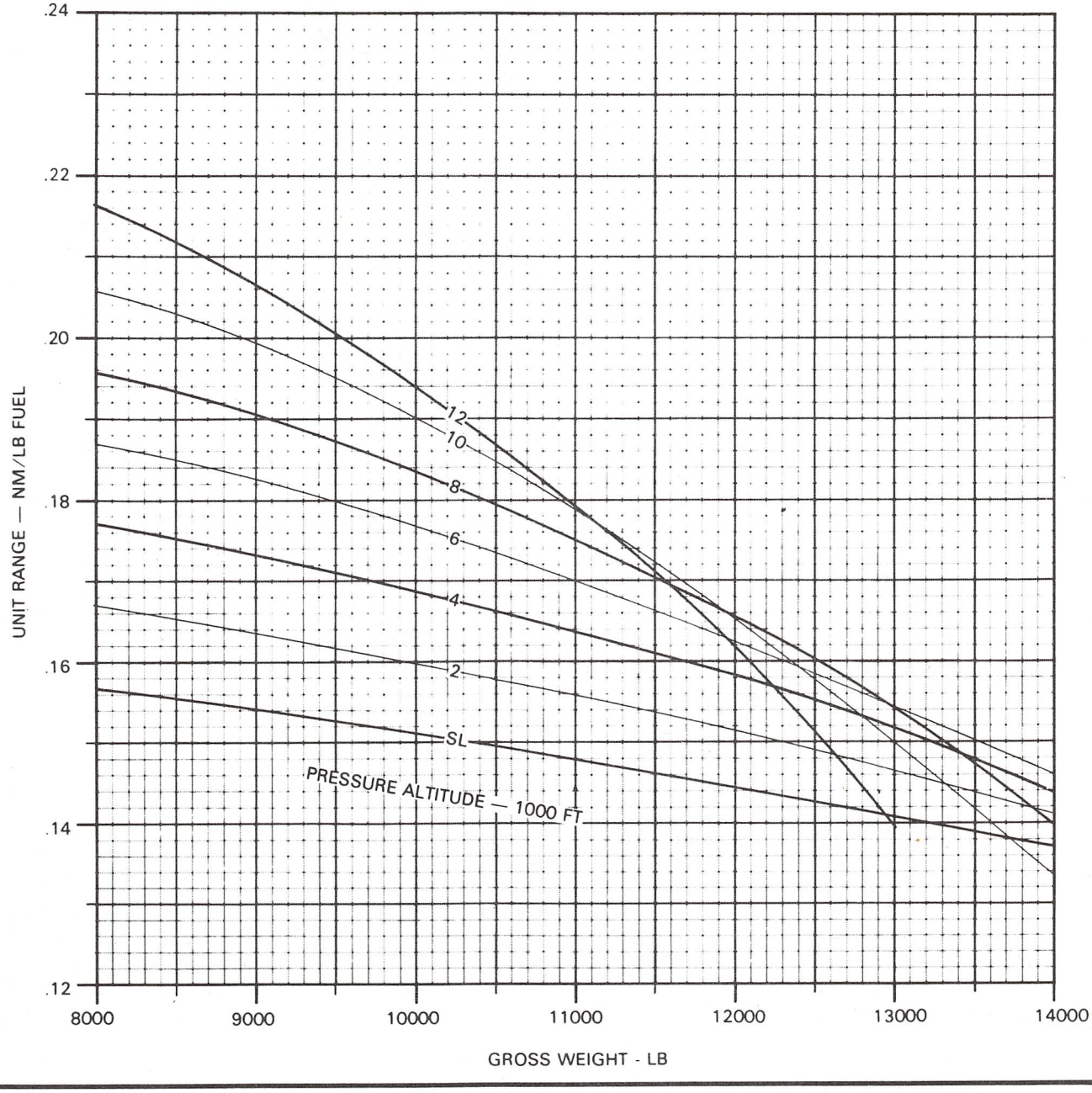


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 2 of 8)

BEST RANGE

OAT BETWEEN -10°C AND +10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

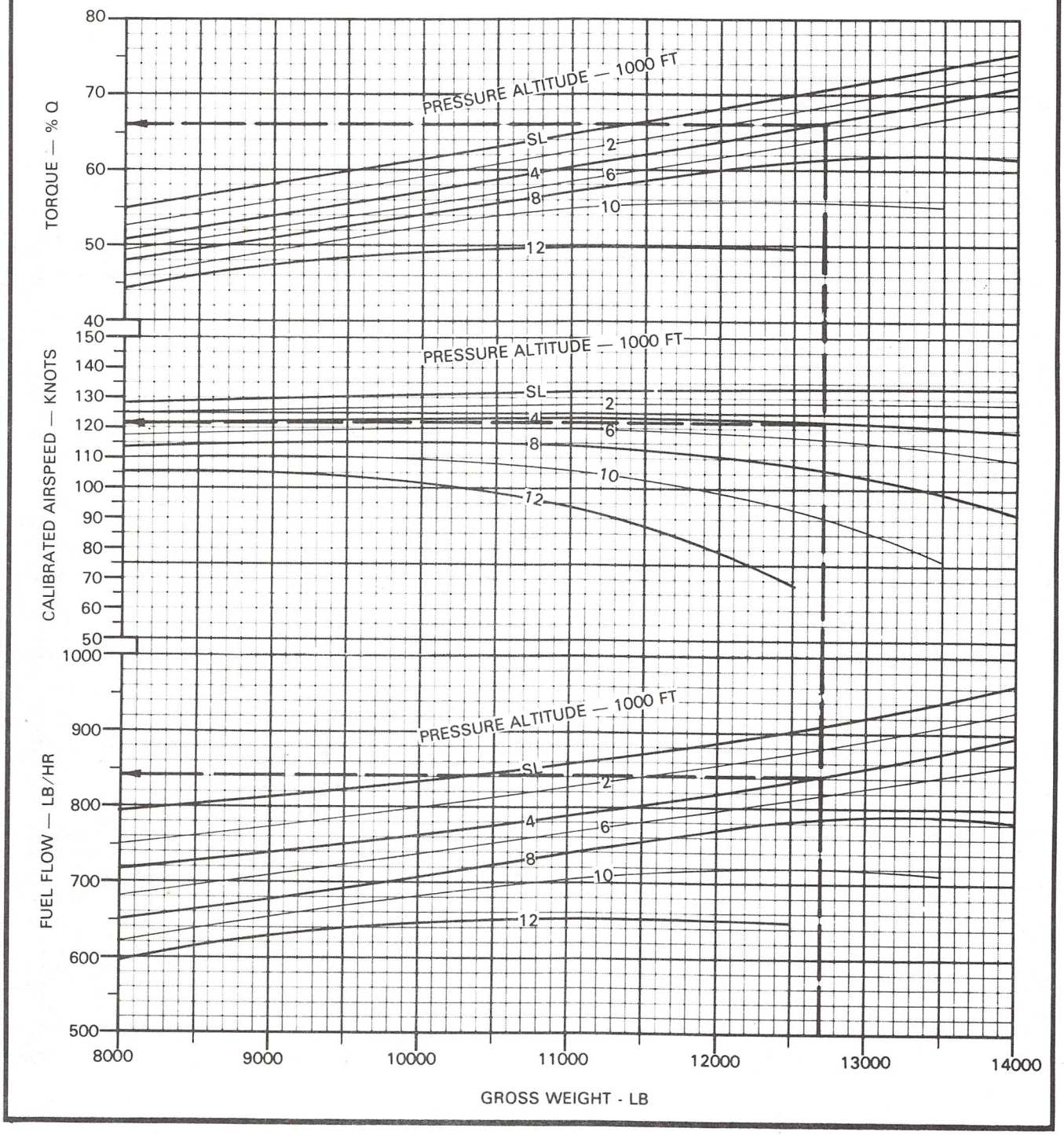


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 3 of 8)

BEST RANGE

OAT BETWEEN -10°C AND +10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

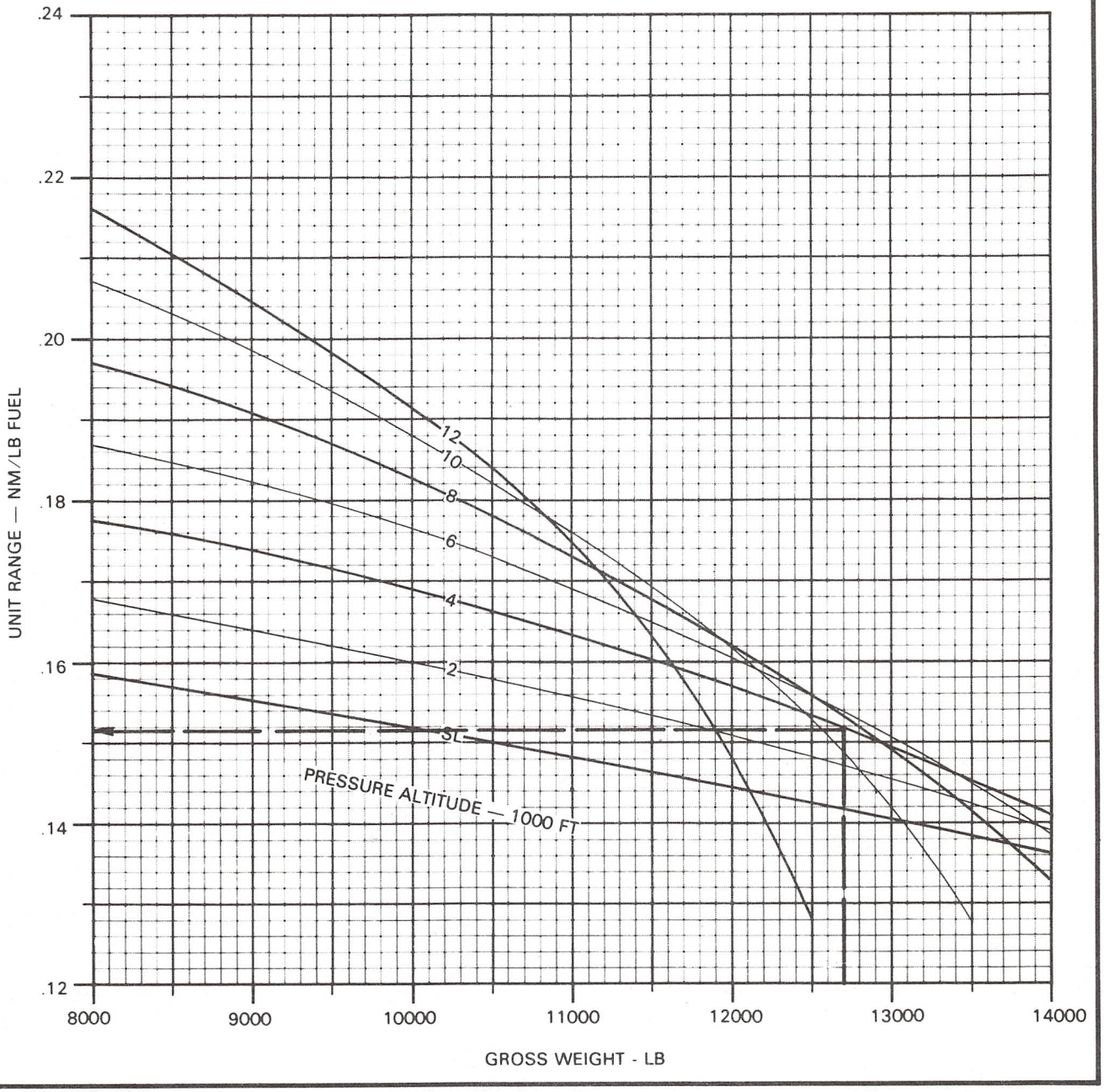


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 4 of 8)

BEST RANGE

OAT BETWEEN +10° AND +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

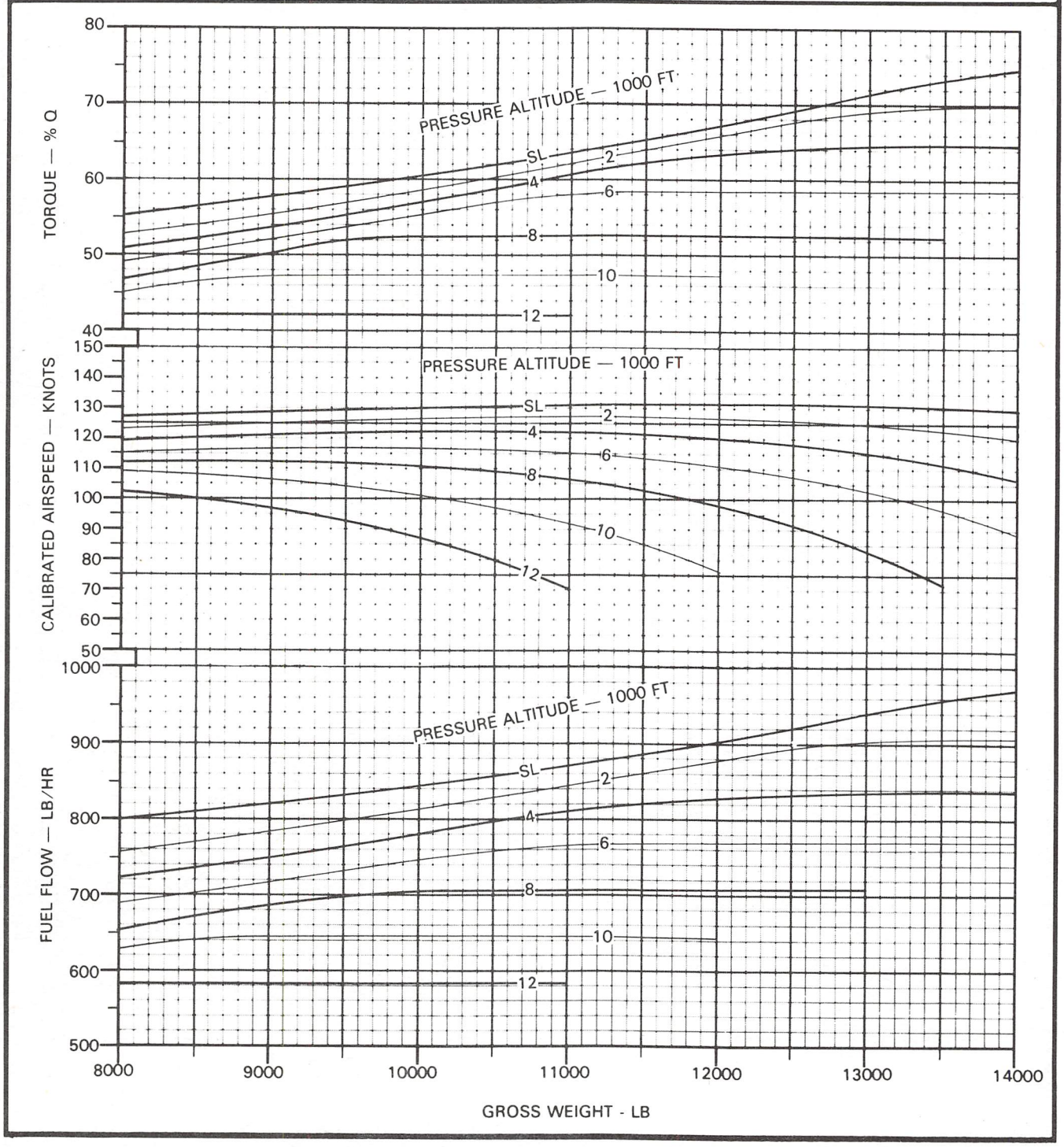


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 5 of 8)

BEST RANGE

OAT BETWEEN +10° AND +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

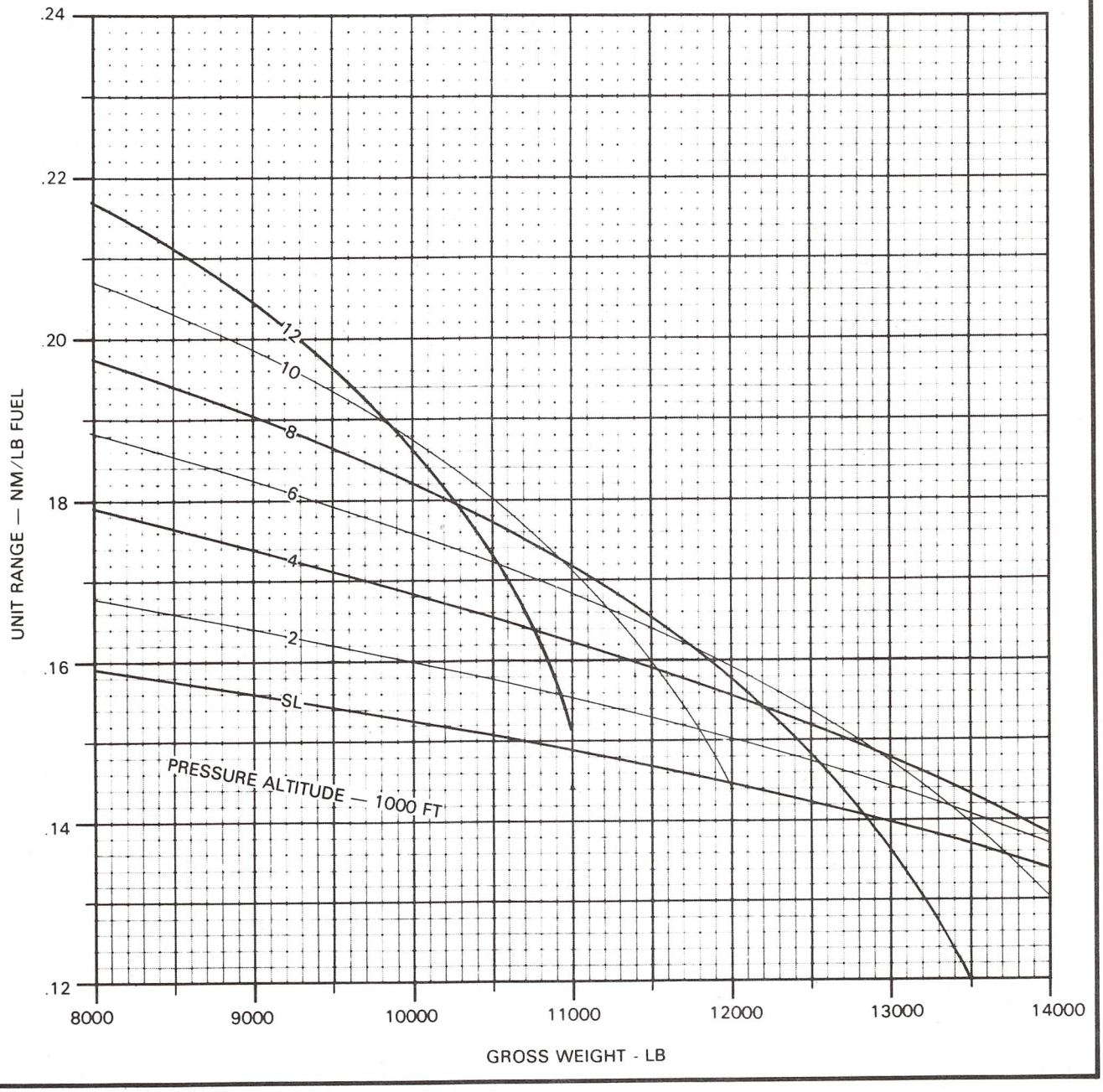


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 6 of 8)

BEST RANGE

OAT HOTTER THAN +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

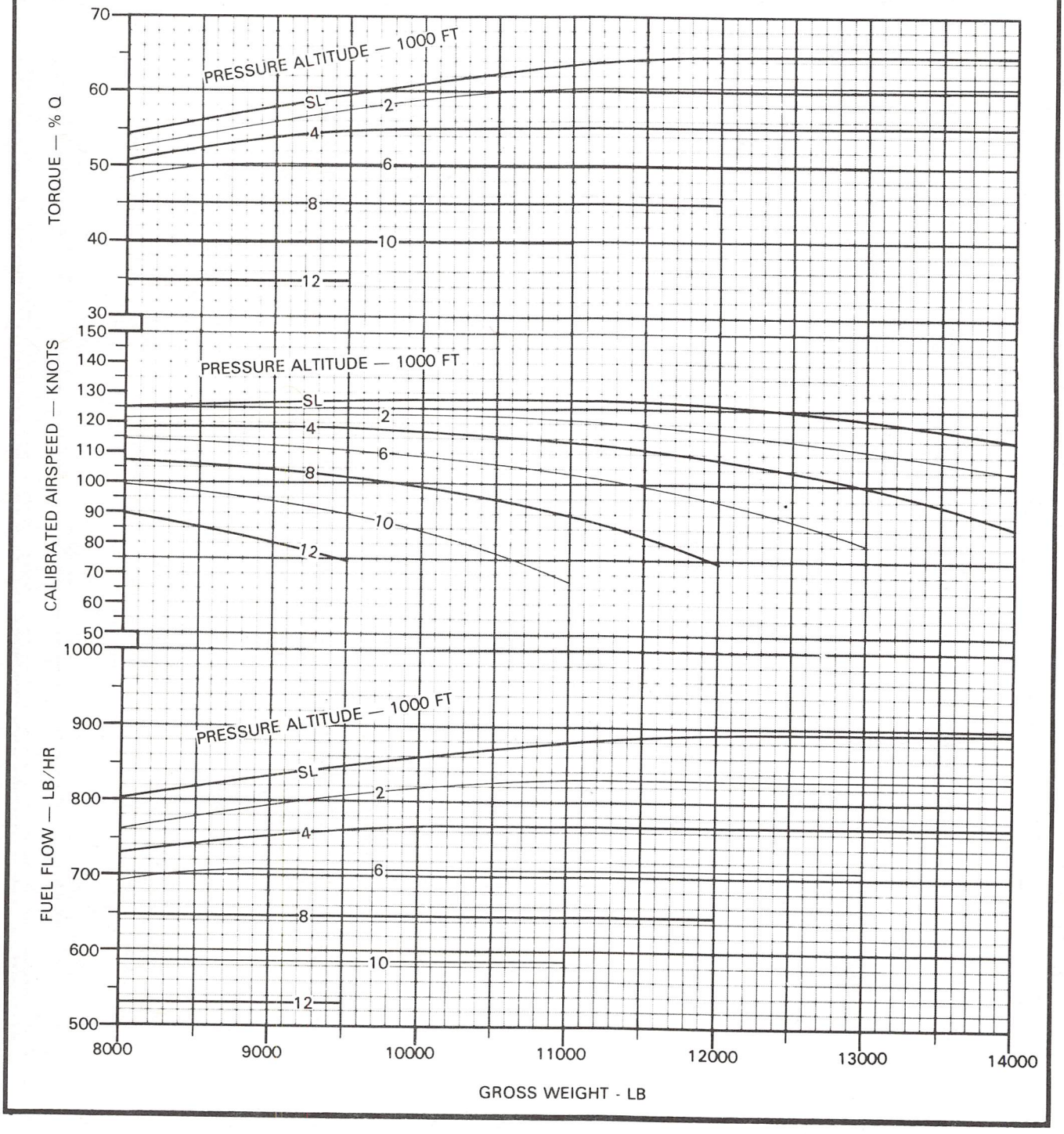


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 7 of 8)

BEST RANGE

OAT HOTTER THAN +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

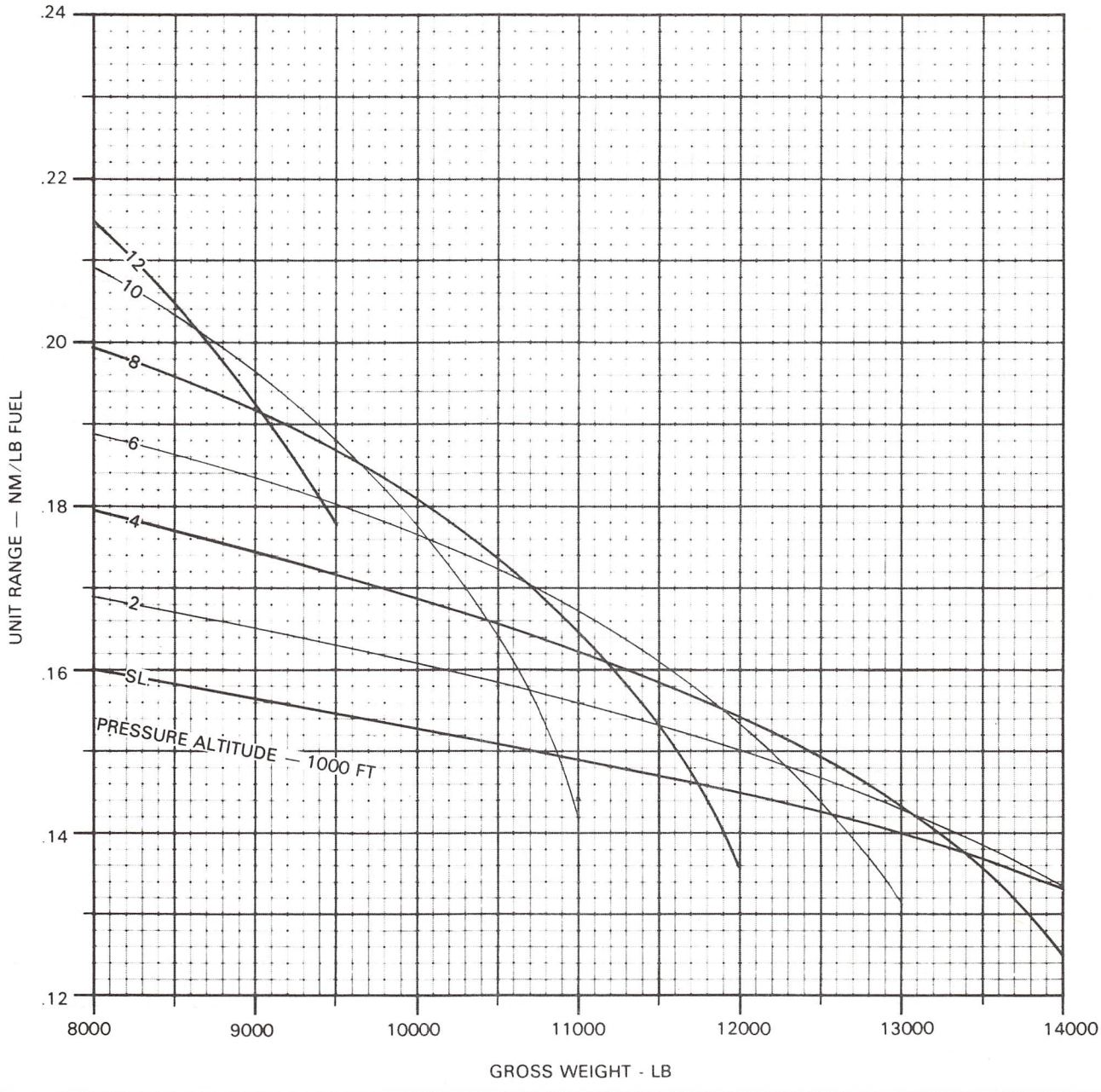


Figure 11-11. Best range (8 TOW missile configuration) chart (Sheet 8 of 8)

BEST RANGE

OAT COLDER THAN -10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

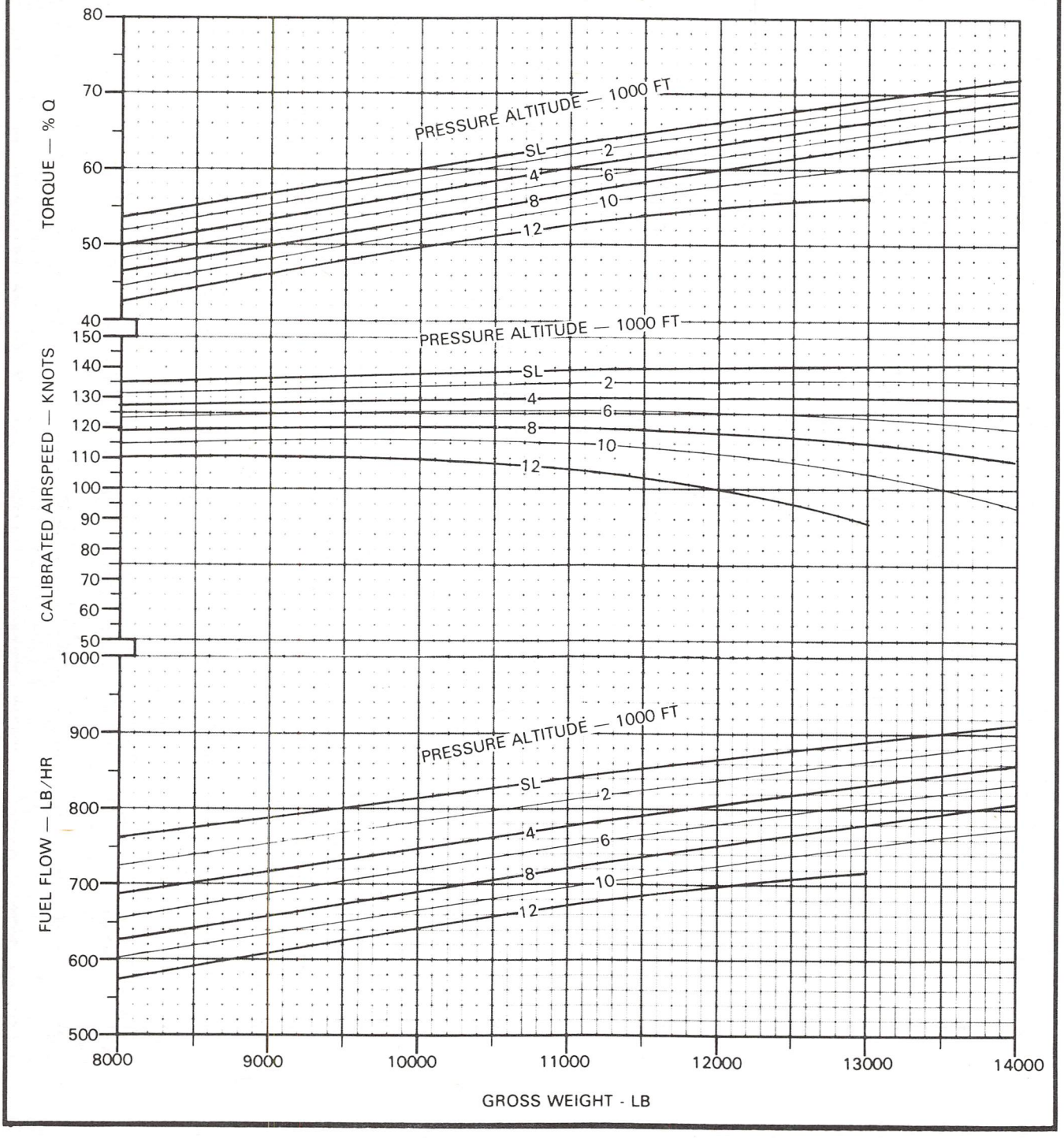


Figure 11-12. Best range (clean configuration) chart (Sheet 1 of 8)

BEST RANGE

OAT COLDER THAN -10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

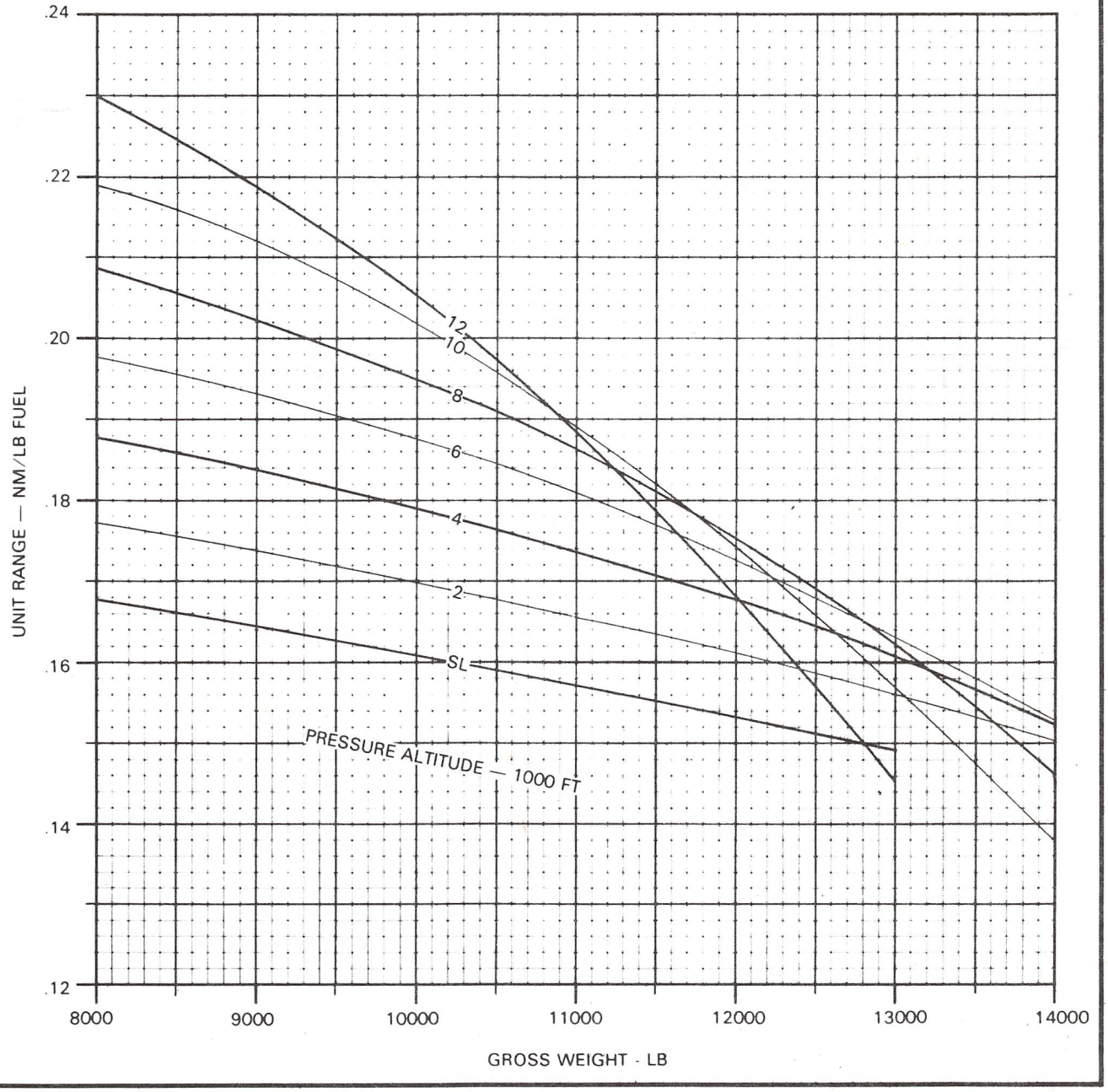


Figure 11-12. Best range (clean configuration) chart (Sheet 2 of 8)

BEST RANGE

OAT BETWEEN -10°C AND +10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

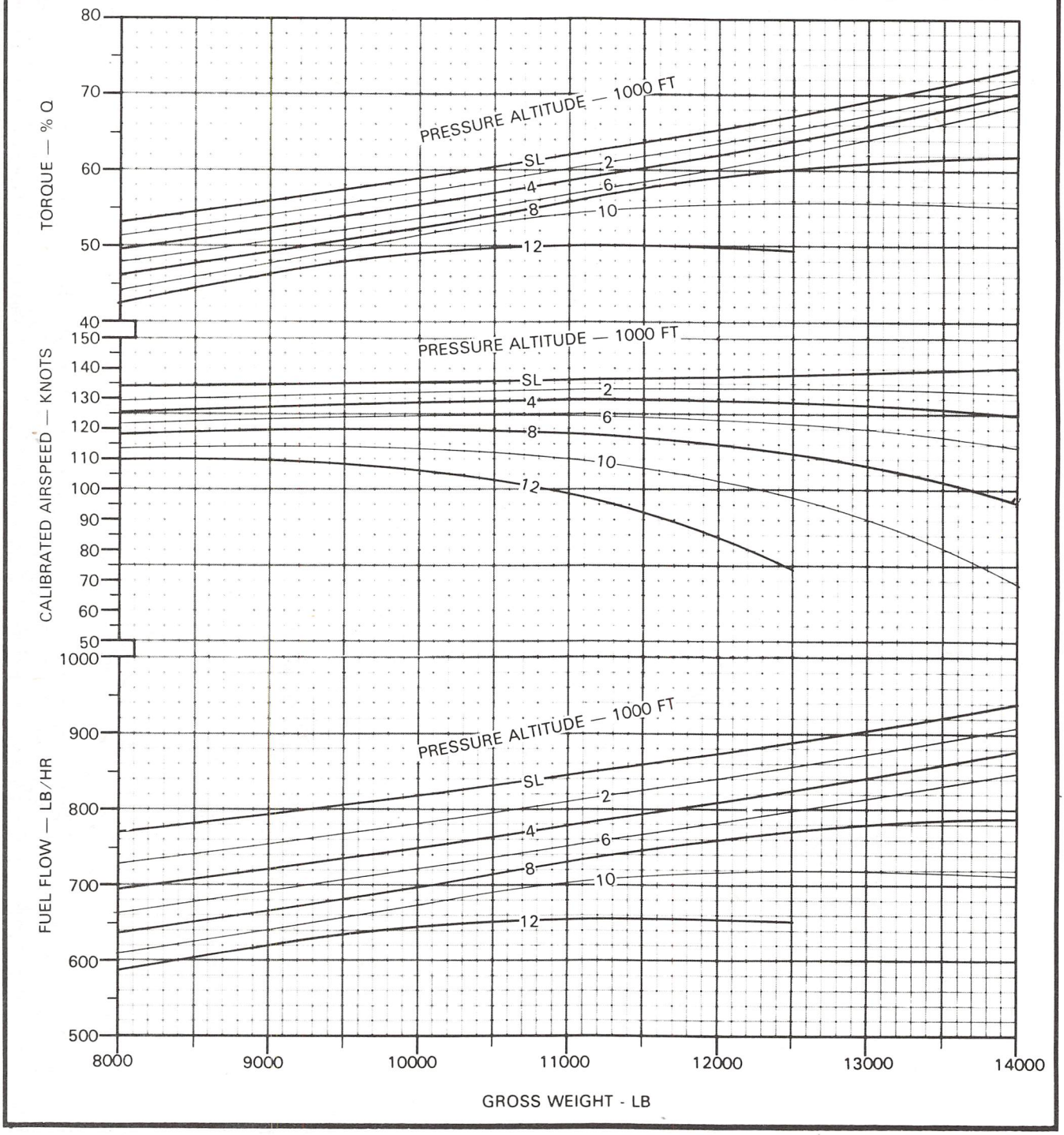


Figure 11-12. Best range (clean configuration) chart (Sheet 3 of 8)

BEST RANGE

OAT BETWEEN -10°C AND +10°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

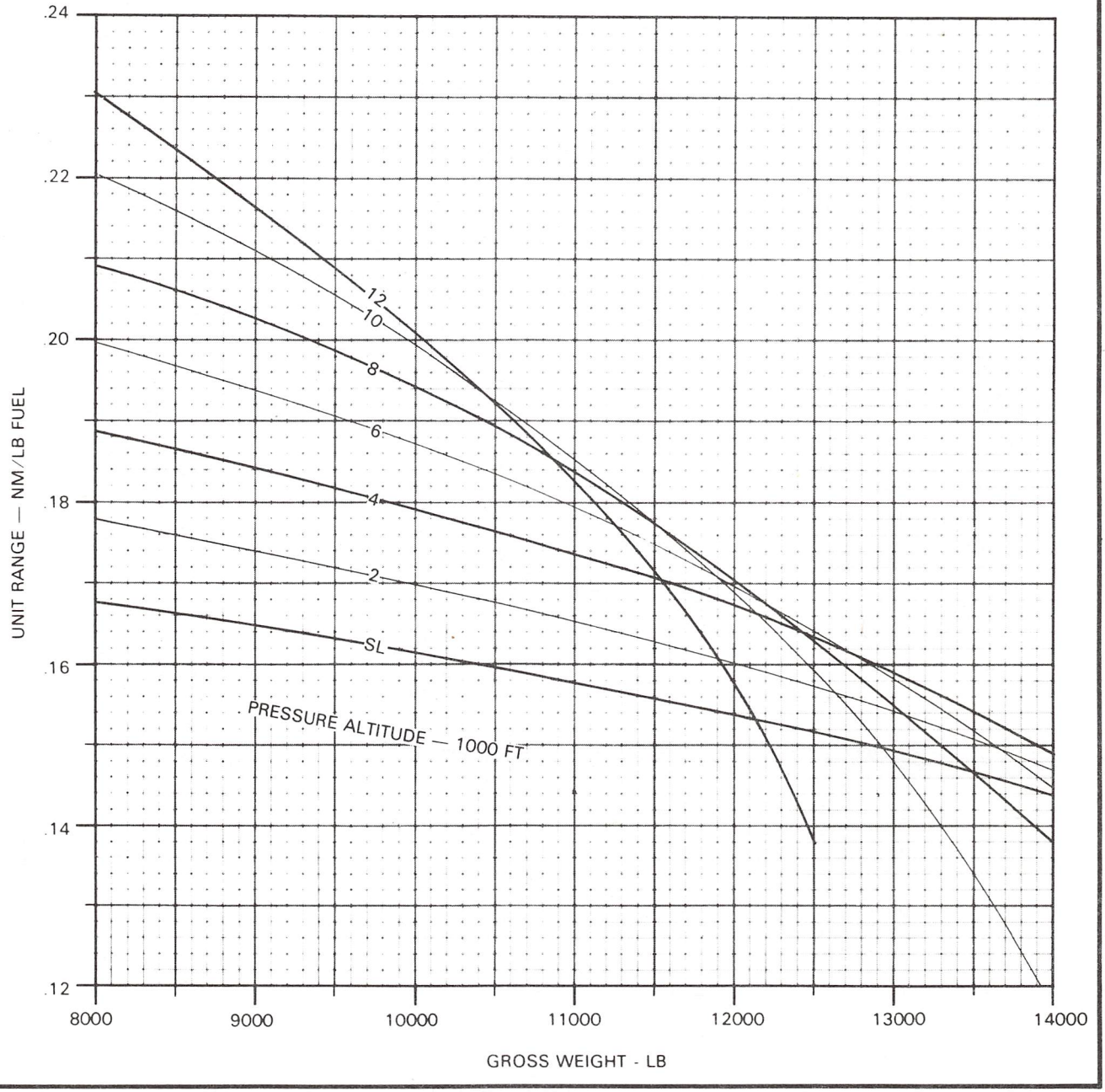


Figure 11-12. Best range (clean configuration) chart (Sheet 4 of 8)

BEST RANGE

OAT BETWEEN +10° AND +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

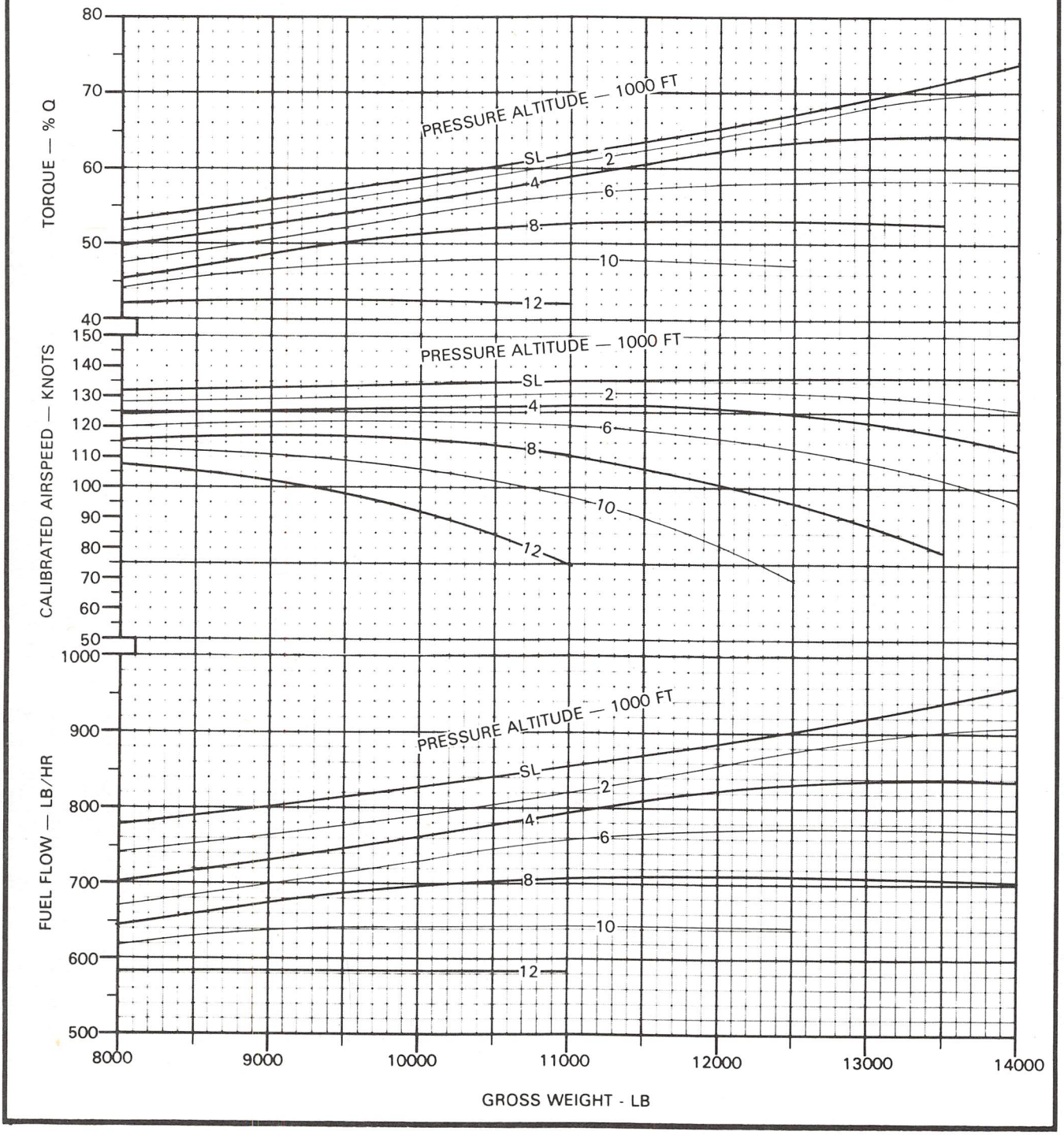


Figure 11-12. Best range (clean configuration) chart (Sheet 5 of 8)

BEST RANGE

OAT BETWEEN +10° AND +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

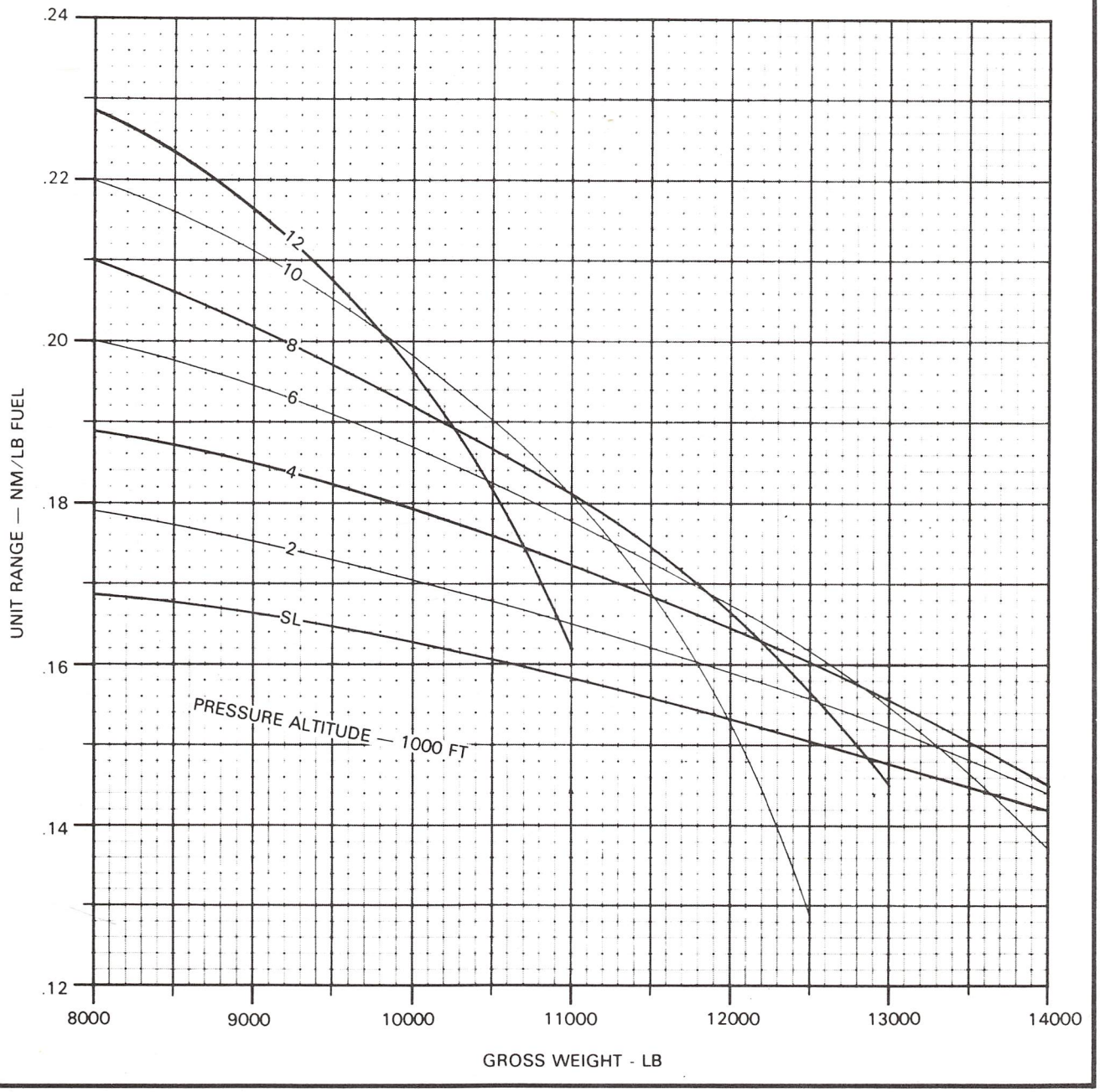


Figure 11-12. Best range (clean configuration) chart (Sheet 6 of 8)

BEST RANGE

OAT HOTTER THAN +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

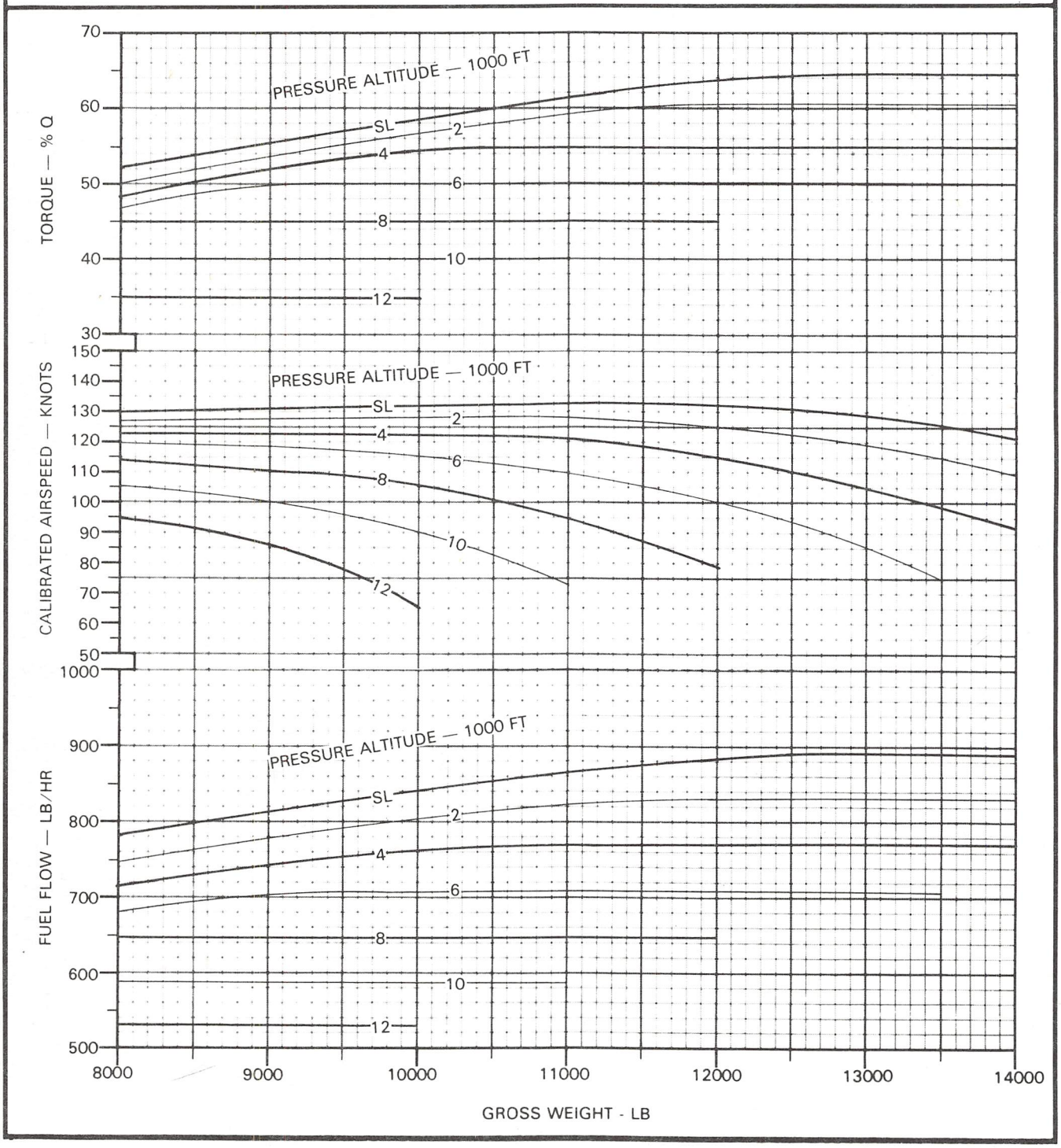


Figure 11-12. Best range (clean configuration) chart (Sheet 7 of 8)

BEST RANGE

OAT HOTTER THAN +25°C

TWO ENGINE OPERATION AT LONG RANGE CRUISE
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

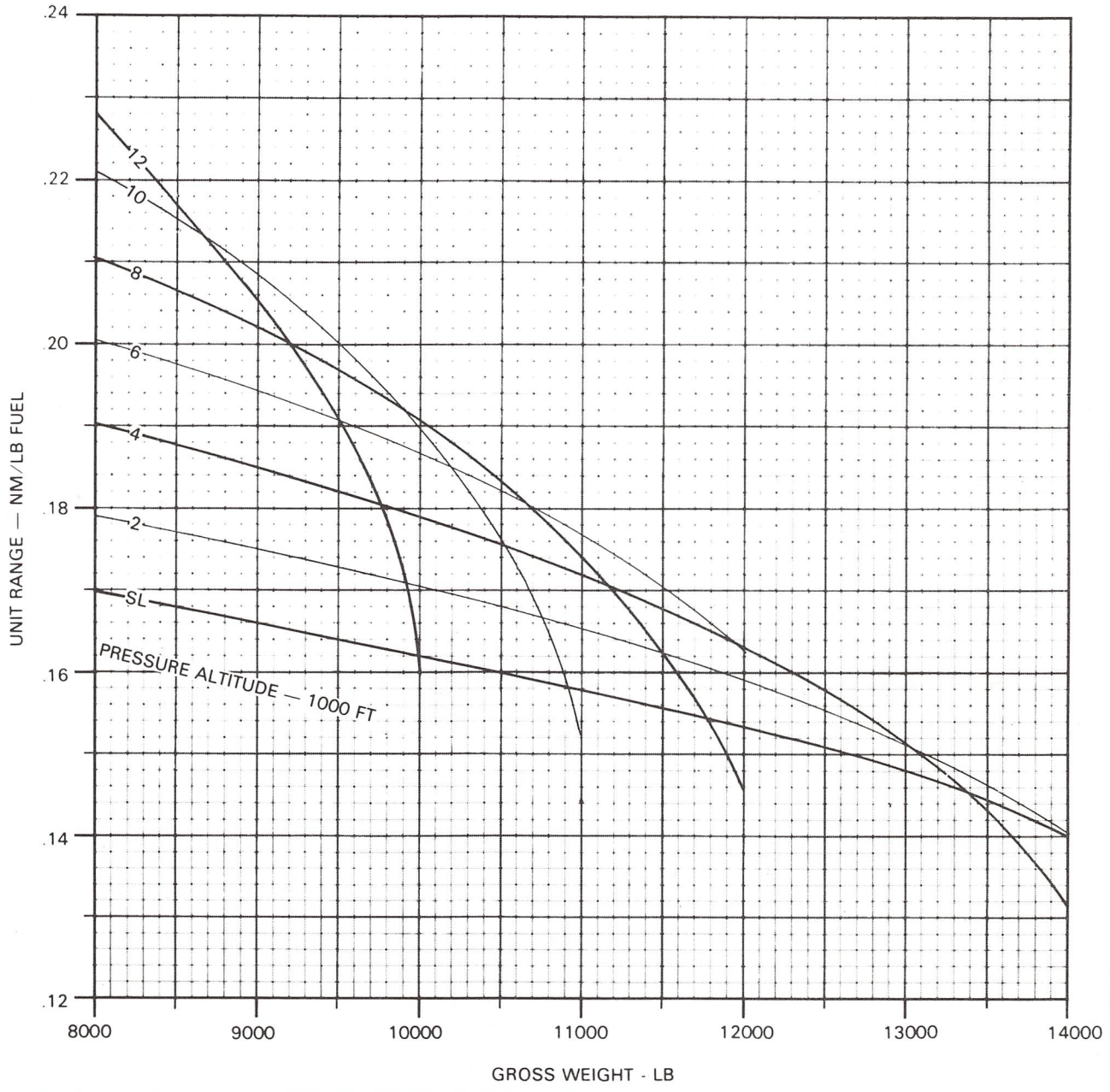


Figure 11-12. Best range (clean configuration) chart (Sheet 8 of 8)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT COLDER THAN -10°C

TWO ENGINE OPERATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATIONS		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	85.0 %Q	1036 LB/HR
2000	84.9	1032
4000	83.5	1009
6000	76.2	931
8000	69.3	858
10000	62.8	781
12000	56.6	716

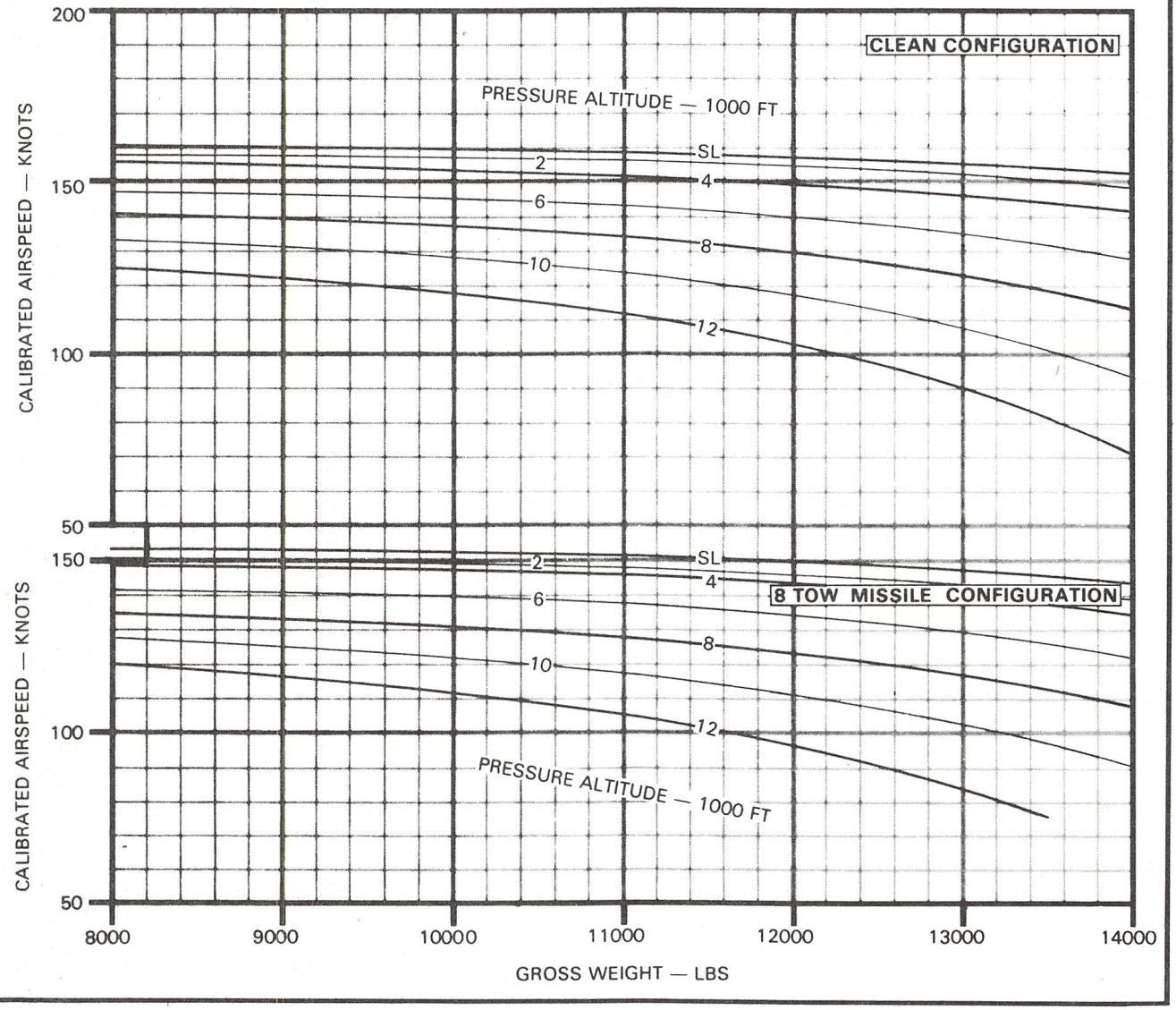


Figure 11-13. Range at maximum continuous power chart (Sheet 1 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT COLDER THAN -10°C

TWO ENGINE OPERATION
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

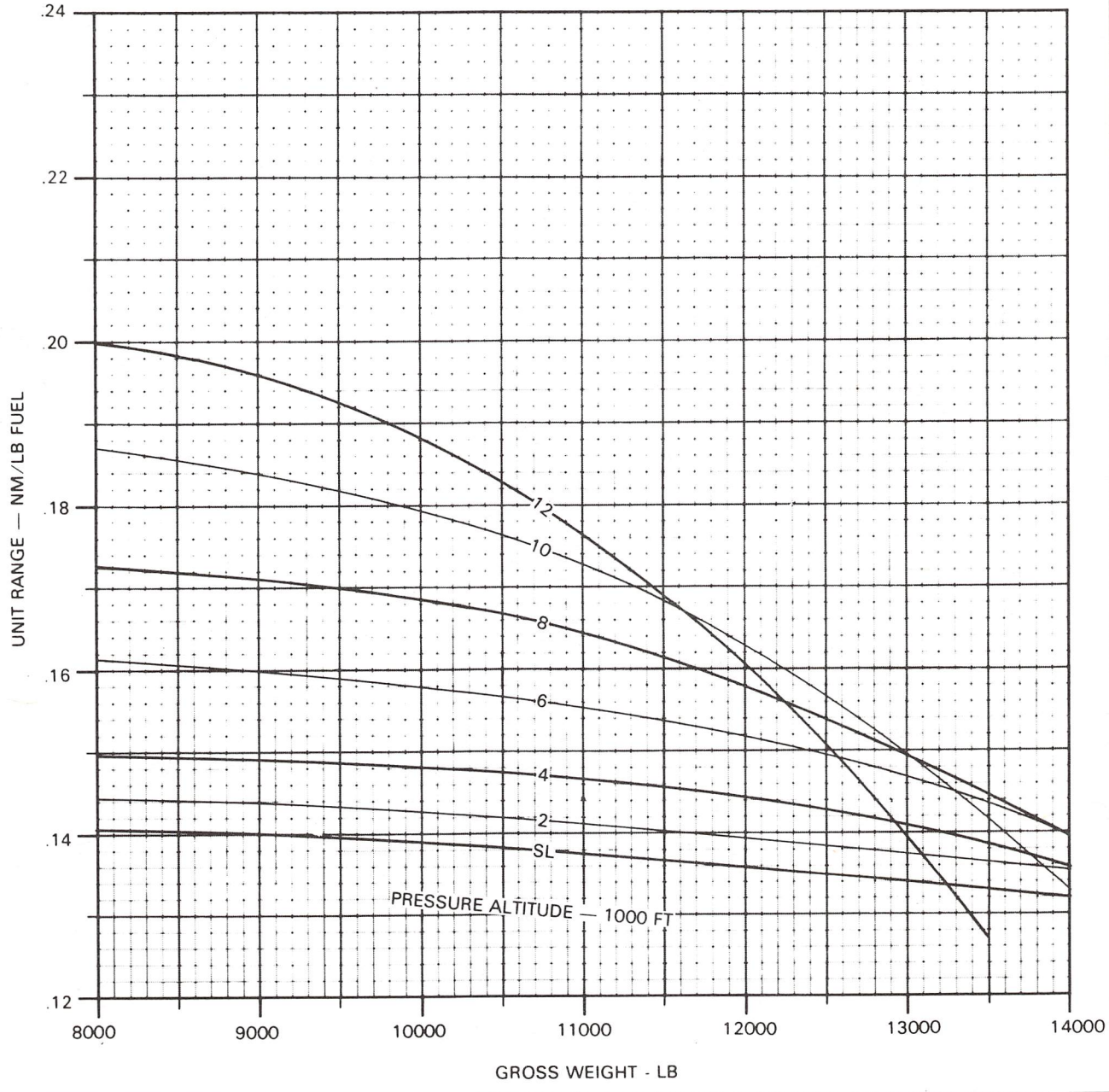


Figure 11-13. Range at maximum continuous power chart (Sheet 2 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT COLDER THAN -10°C

TWO ENGINE OPERATION
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

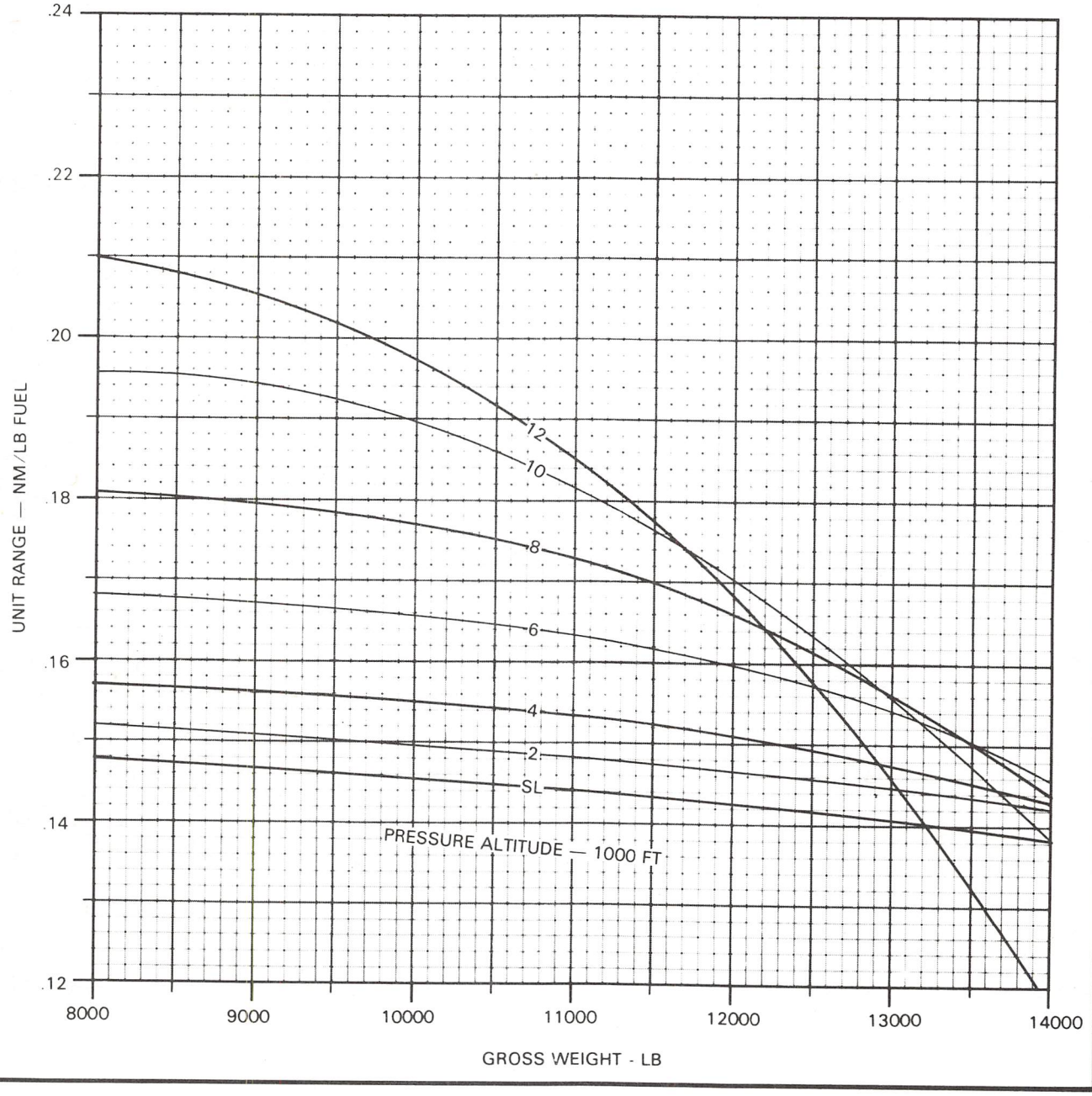


Figure 11-13. Range at maximum continuous power chart (Sheet 3 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT BETWEEN -10°C AND +10°C

TWO ENGINE OPERATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATIONS		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	85.0 %Q	1052 LB/HR
2000	82.4	1019
4000	75.3	934
6000	68.5	859
8000	61.9	787
10000	55.6	715
12000	49.9	653

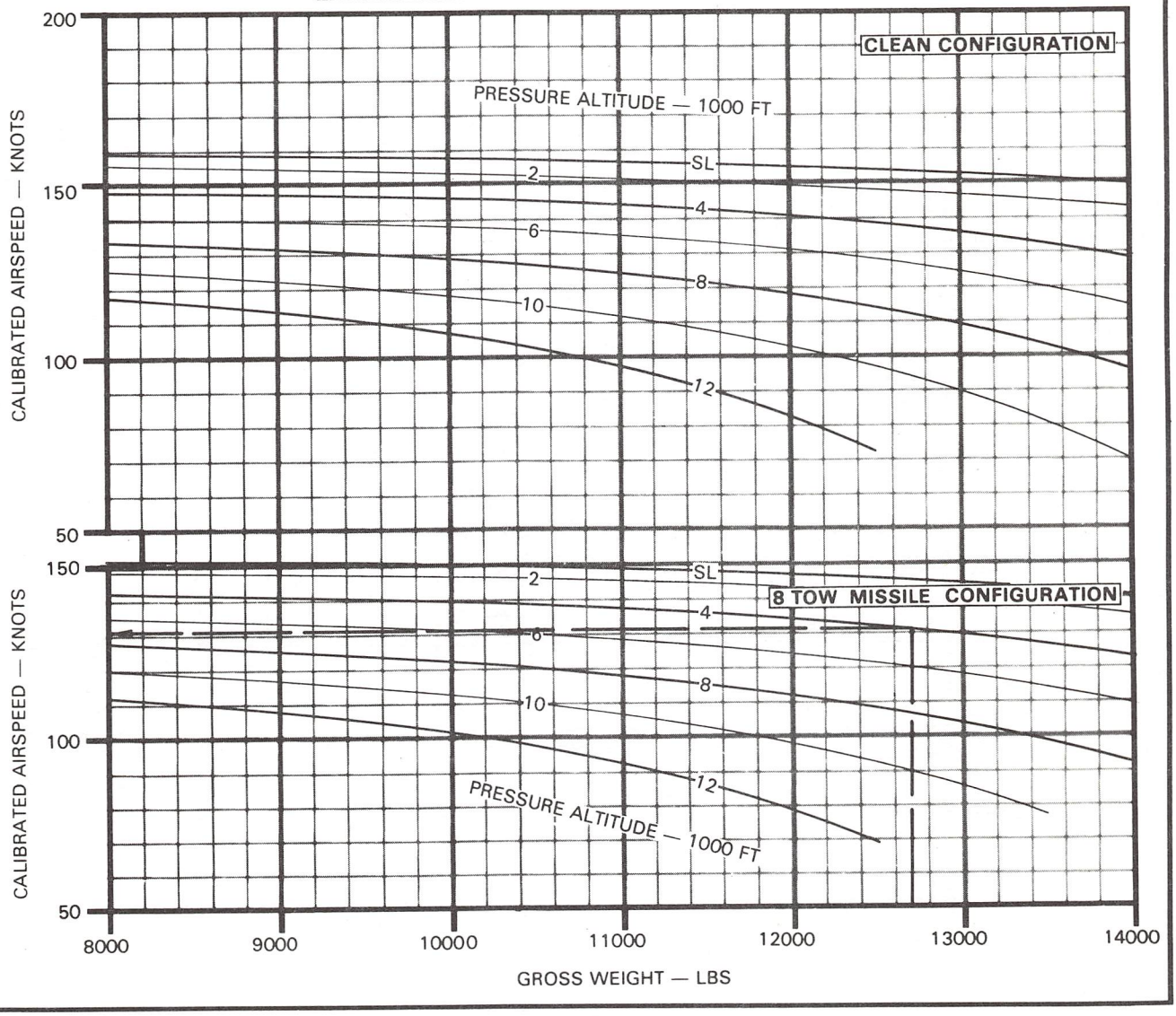


Figure 11-13. Range at maximum continuous power chart (Sheet 4 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT BETWEEN -10°C AND +10°C

TWO ENGINE OPERATION
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

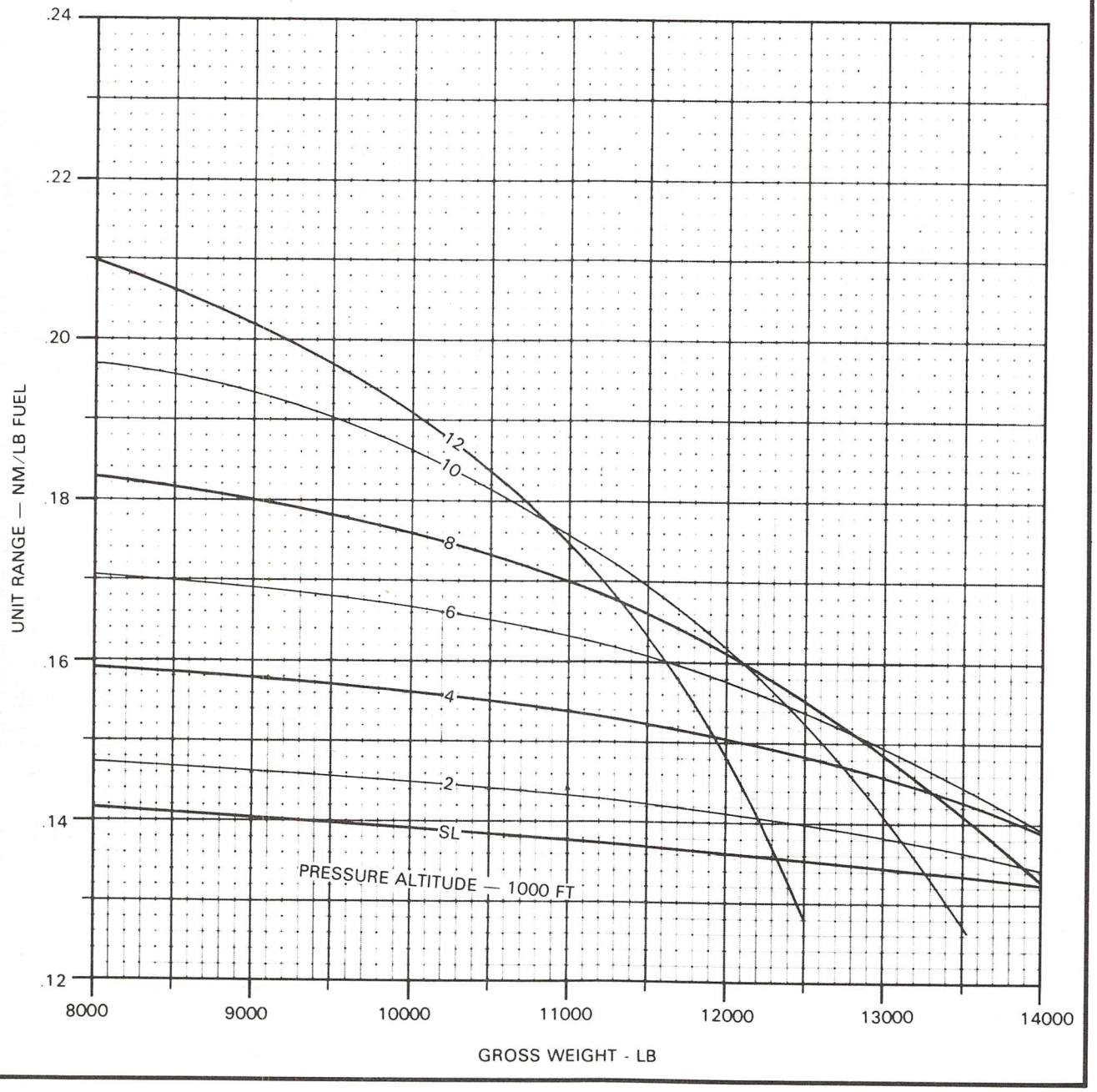


Figure 11-13. Range at maximum continuous power chart (Sheet 5 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT BETWEEN -10°C AND +10°C

TWO ENGINE OPERATION
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

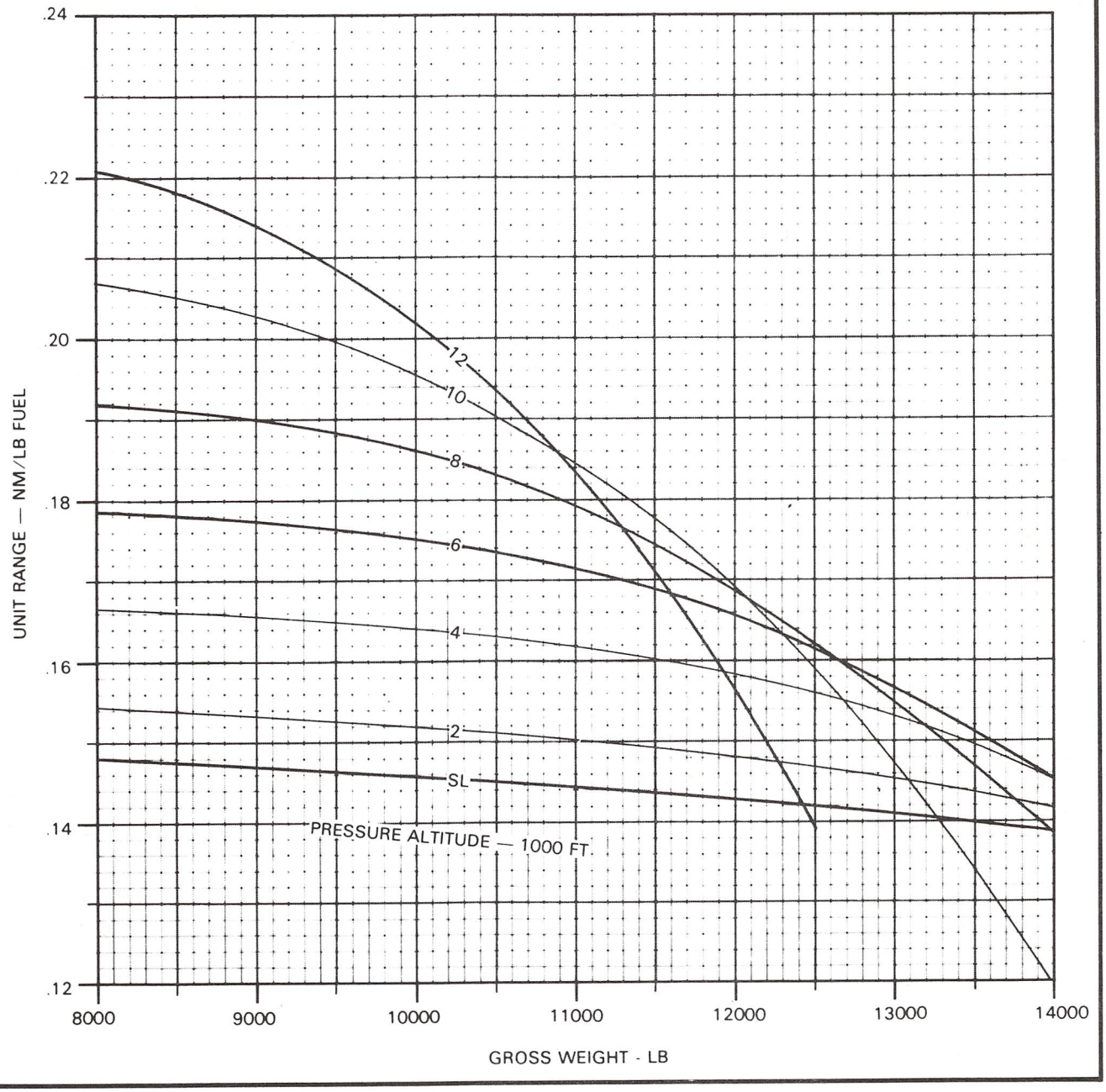


Figure 11-13. Range at maximum continuous power chart (Sheet 6 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT BETWEEN +10°C AND +25°C

TWO ENGINE OPERATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATIONS		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	74.9 %Q	971 LB/HR
2000	69.7	907
4000	64.1	837
6000	58.5	771
8000	52.8	709
10000	47.4	645
12000	42.1	588

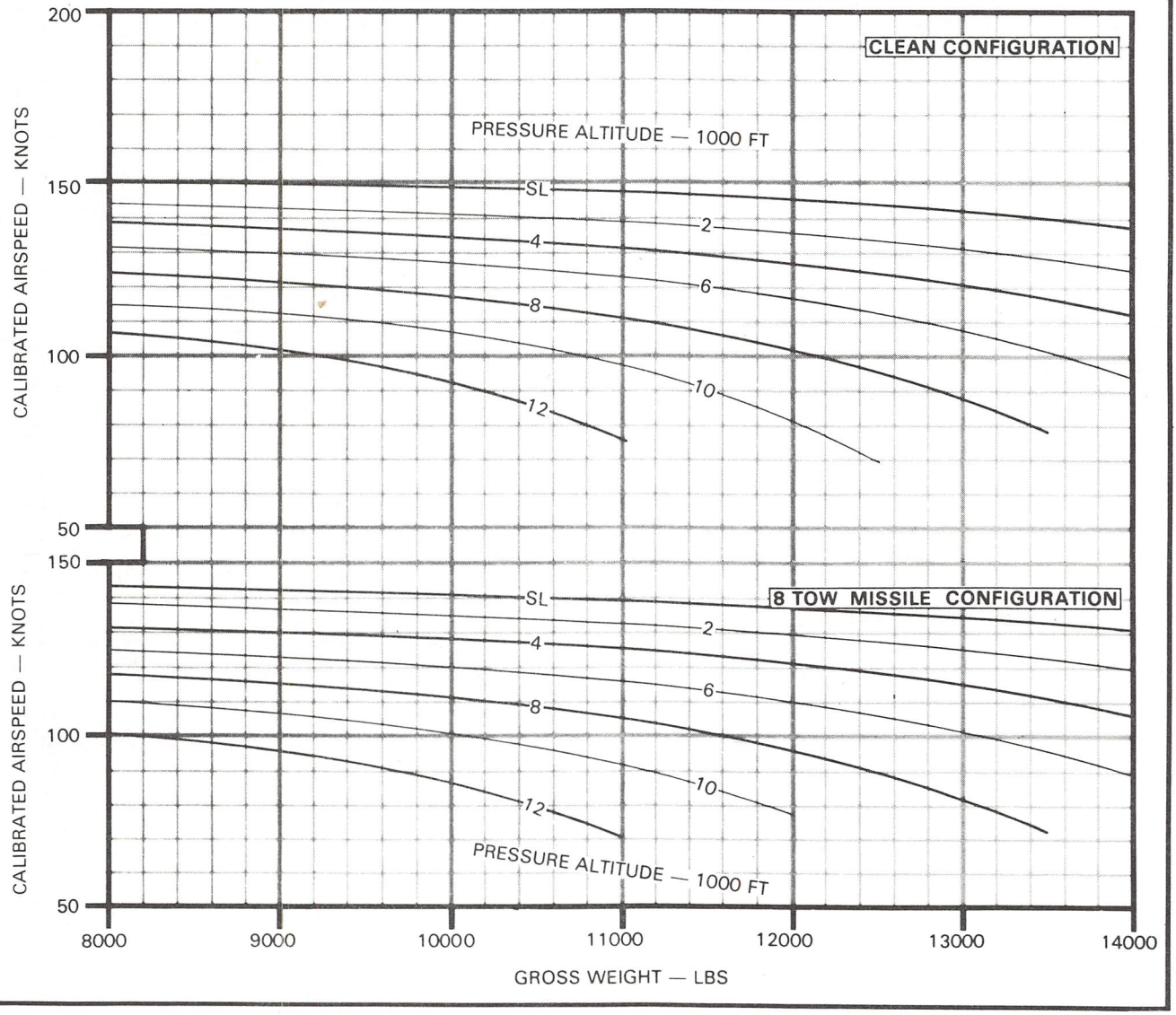


Figure 11-13. Range at maximum continuous power chart (Sheet 7 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT BETWEEN +10°C AND +25°C

TWO ENGINE OPERATION
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

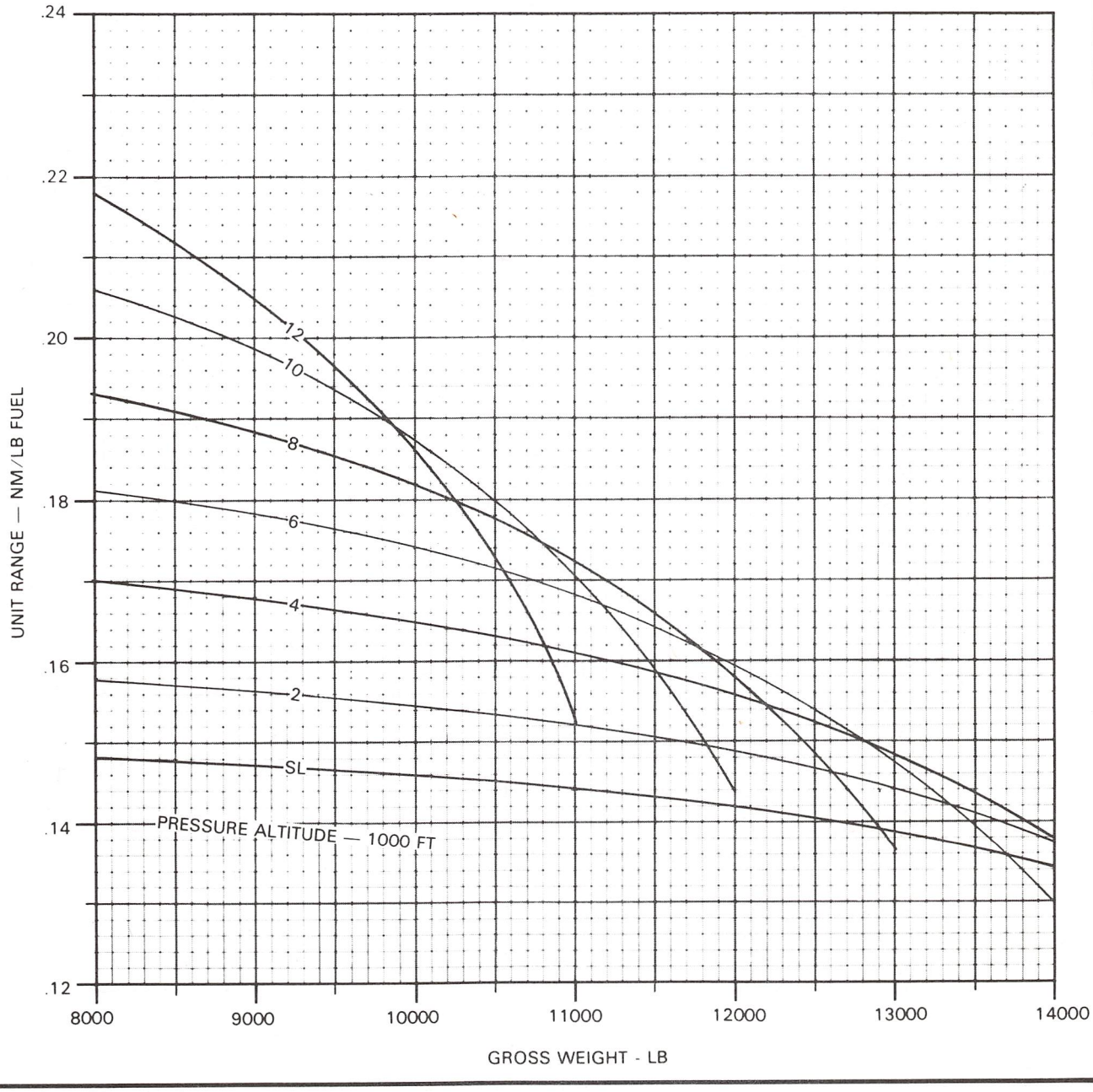


Figure 11-13. Range at maximum continuous power chart (Sheet 8 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT BETWEEN +10°C AND +25°C

TWO ENGINE OPERATION
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

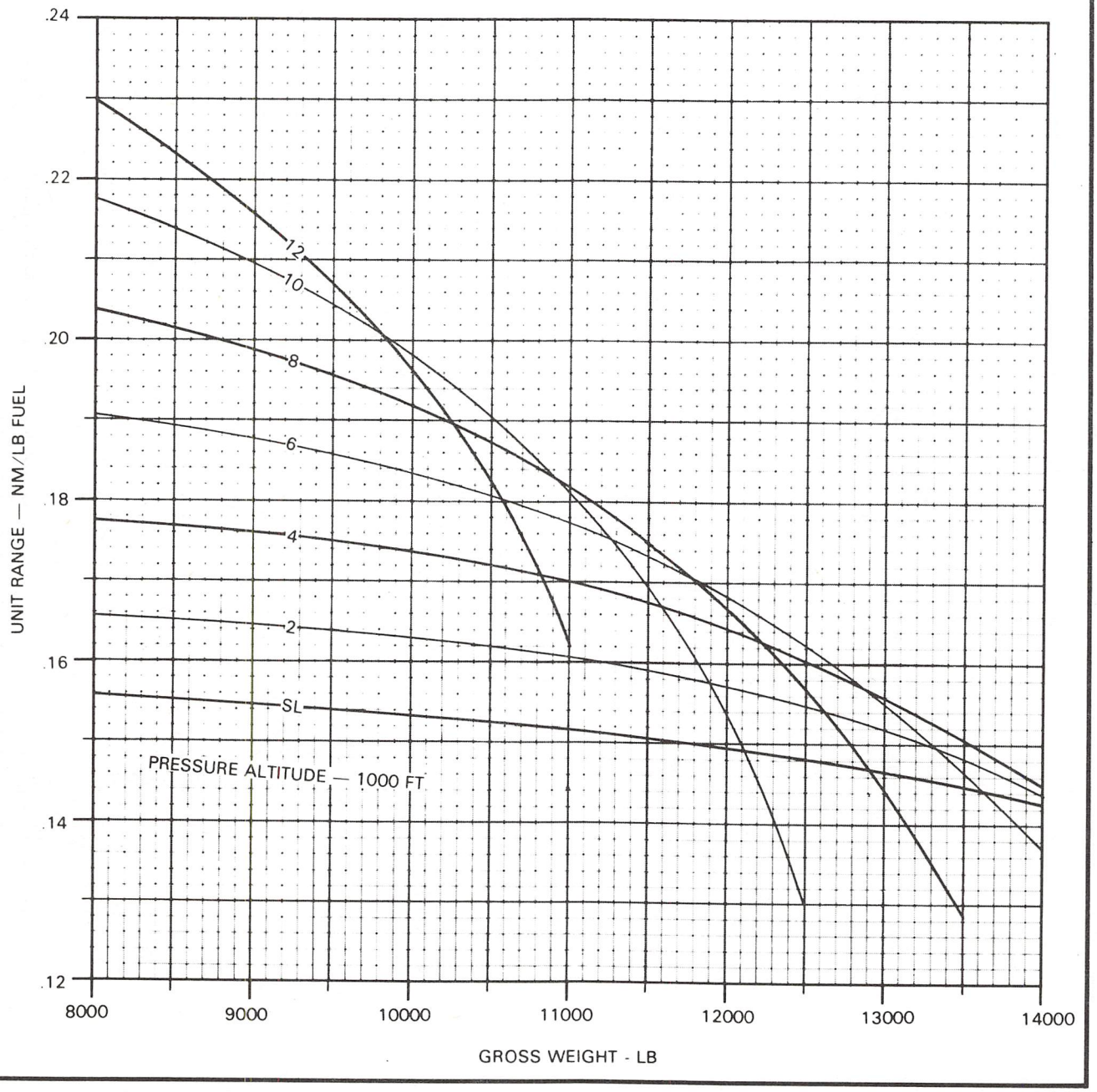


Figure 11-13. Range at maximum continuous power chart (Sheet 9 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT HOTTER THAN +25°C

TWO ENGINE OPERATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATIONS		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	66.4 %Q	892 LB/HR
2000	60.2	833
4000	55.3	769
6000	50.2	707
8000	45.0	648
10000	39.8	588
12000	34.9	533

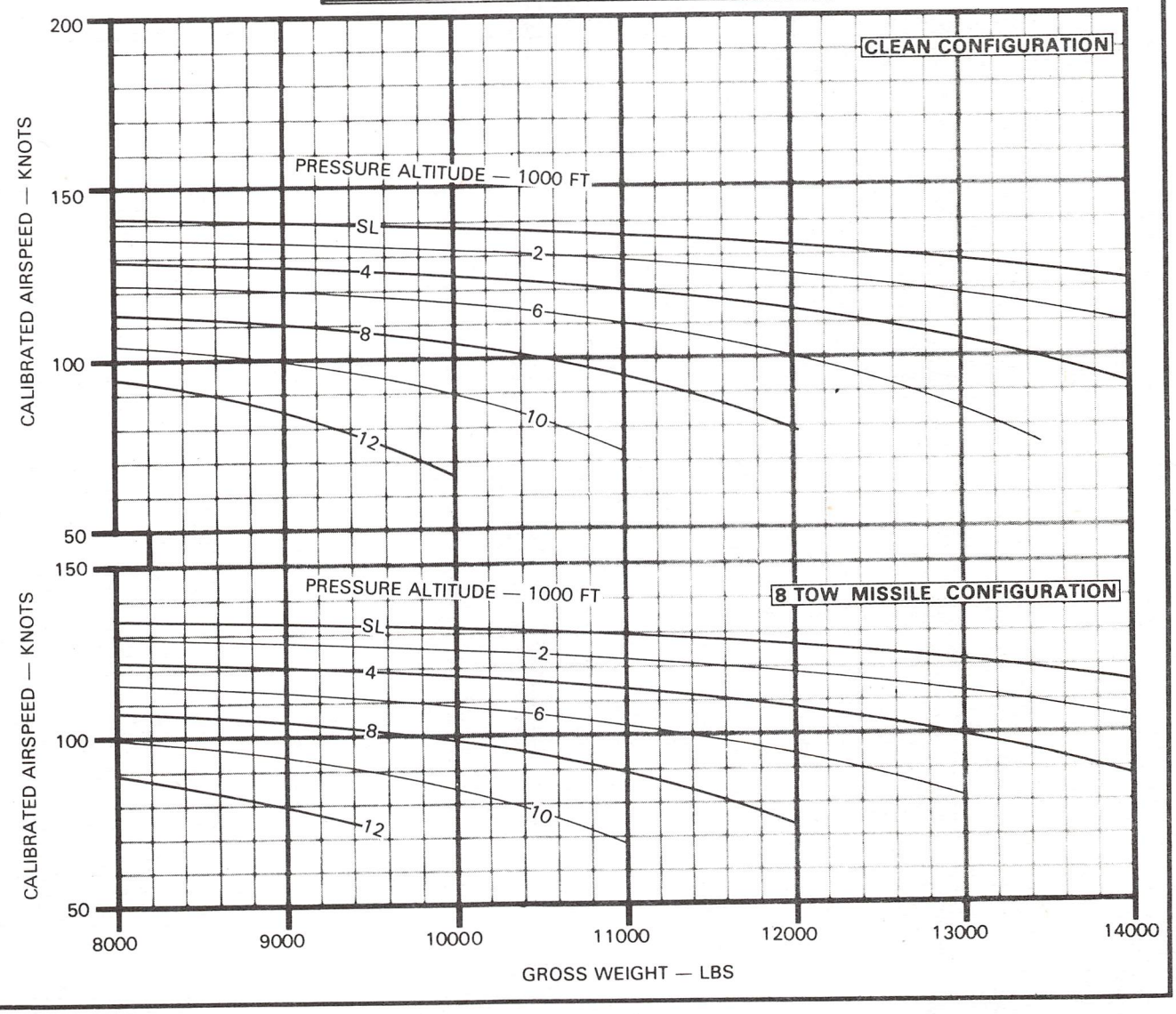


Figure 11-13. Range at maximum continuous power chart (Sheet 10 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT HOTTER THAN +25°C

TWO ENGINE OPERATION
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

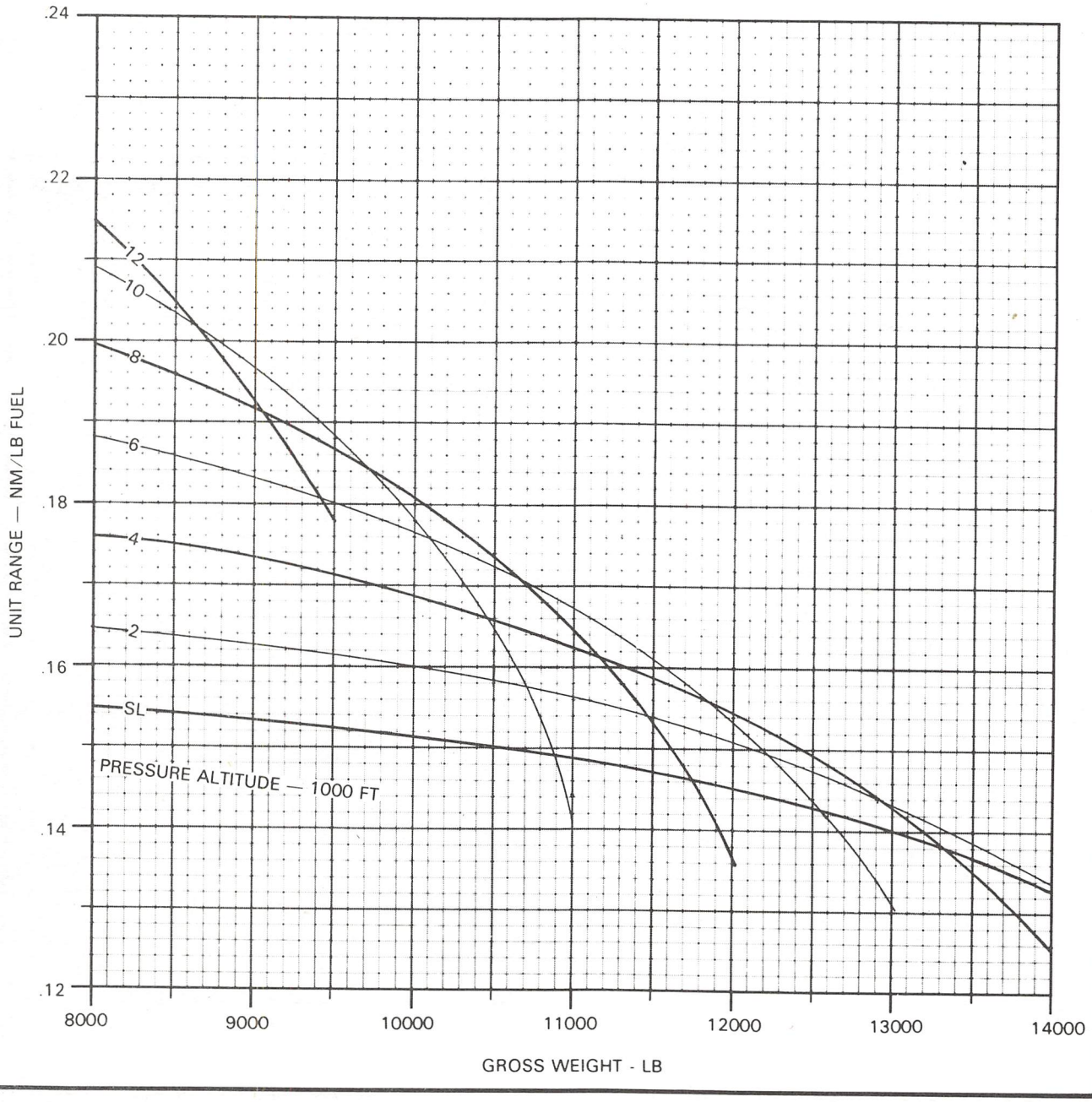


Figure 11-13. Range at maximum continuous power chart (Sheet 11 of 12)

RANGE AT MAXIMUM CONTINUOUS POWER

OAT HOTTER THAN +25°C

TWO ENGINE OPERATION
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

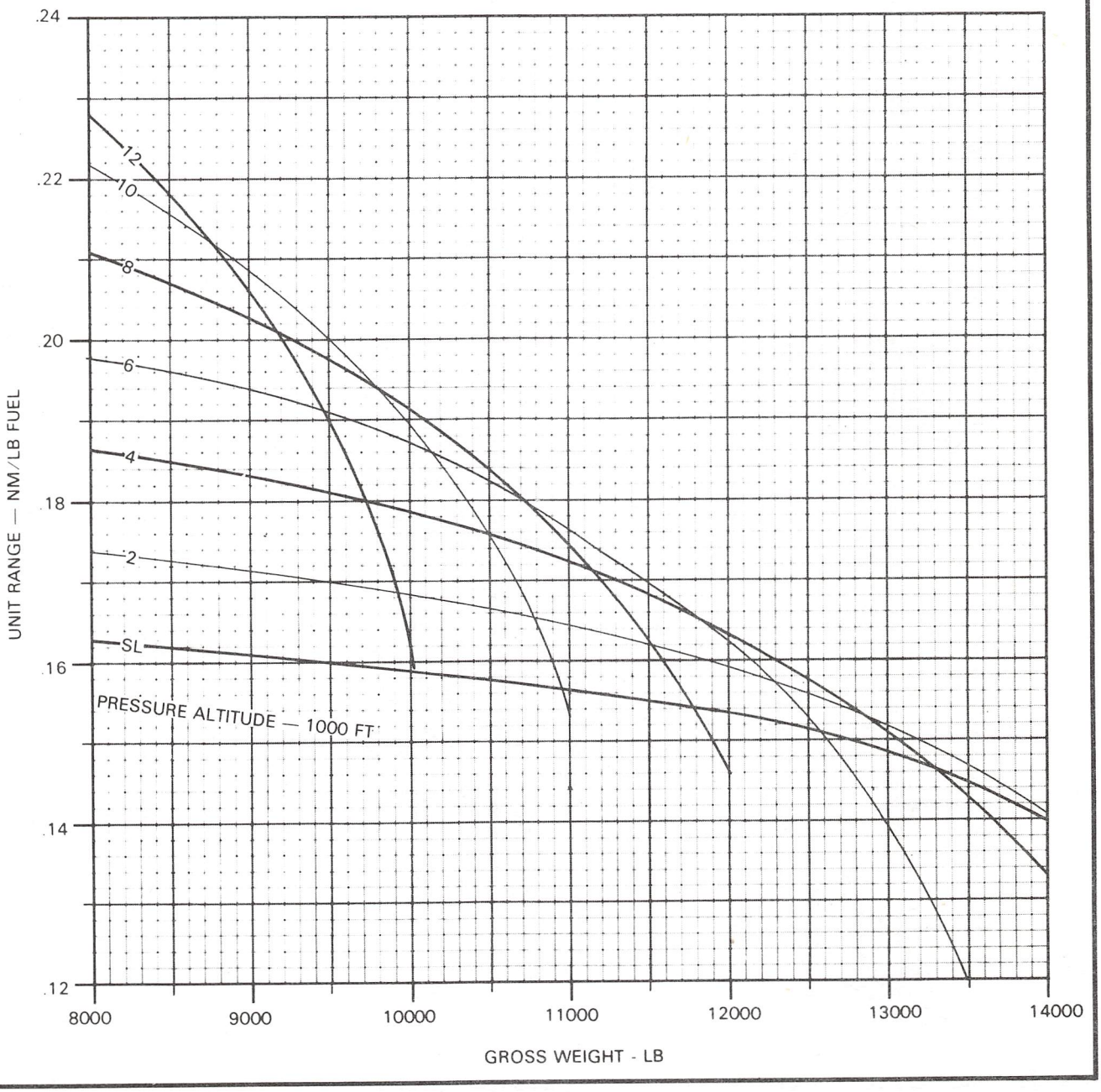


Figure 11-13. Range at maximum continuous power chart (Sheet 12 of 12)

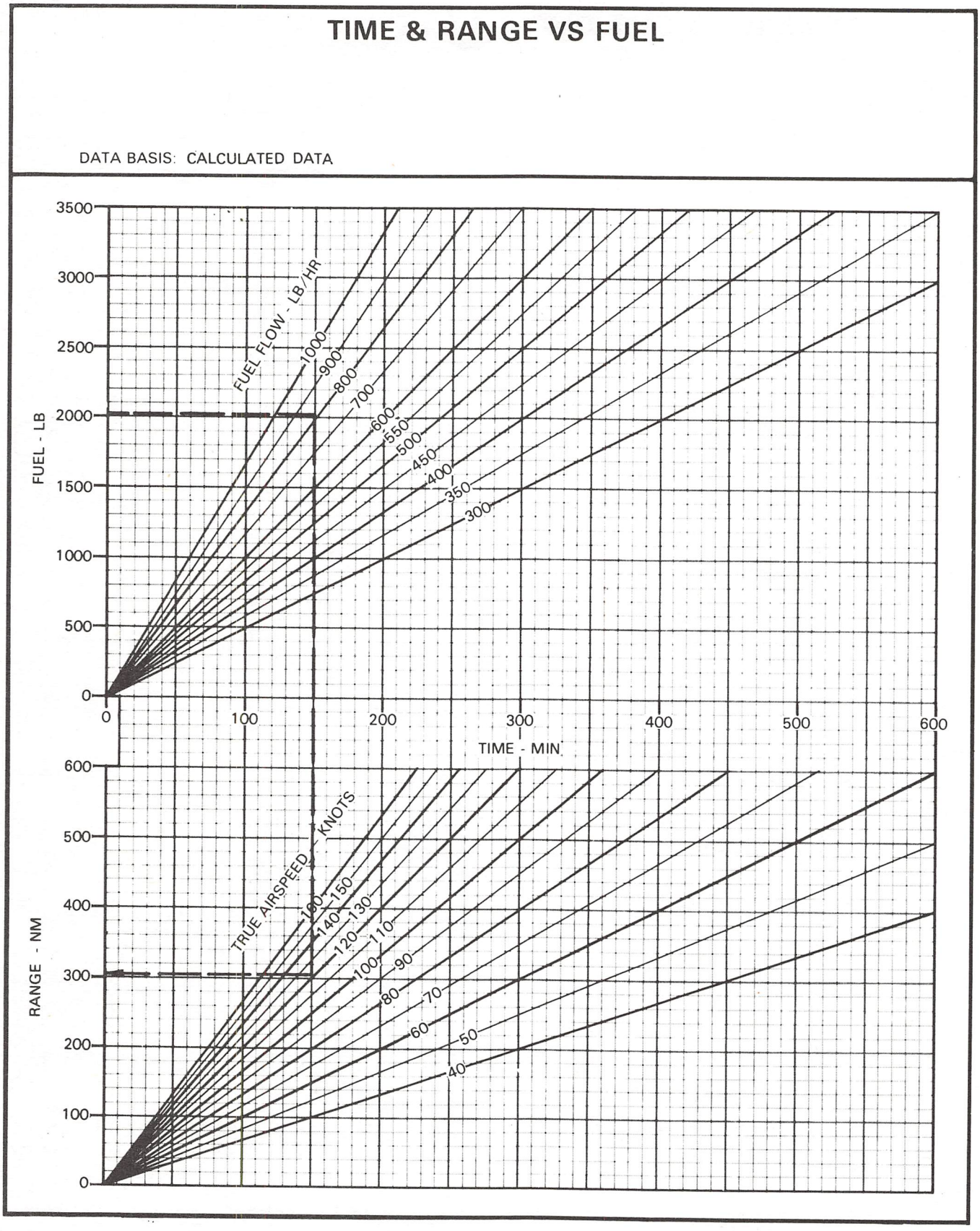


Figure 11-14. Time and range vs fuel chart

PART 5 — ENDURANCE

MAXIMUM ENDURANCE.

The maximum endurance charts (figure 11-15, sheets 1 thru 4, twin engine operation and figure 11-22, sheets 1 thru 4, single engine operation) present torque required, calibrated airspeed and fuel flow as a function of gross weight and pressure altitude for temperature ranges of -10°C and colder, between -10°C and +10°C, between +10°C and +25°C, and +25°C and hotter. Maximum endurance can be determined if gross weight and fuel loading are known.

EXAMPLE: Determine the minimum fuel flow, airspeed, torque required and maximum endurance for a 12,700 pound helicopter, at 4000 feet +7.1°C (standard day), twin engine operation and a fuel loading of 2025 pounds.

Solution:

a. Enter figure 11-15 sheet 2 at 12,700 pounds gross weight.

b. Move up to 4000 feet density altitude lines, and read:

1. Minimum fuel flow required = 626 lb/hr.

2. Minimum airspeed required = 70 KCAS.

3. Minimum torque required = 40%Q.

c. Determine maximum endurance by dividing total fuel load by minimum fuel flow required (2025 ÷ 626 = 3.23 hours).

HOVERING ENDURANCE.

The hover endurance chart (figure 11-16) is shown for out of ground effect at pressure altitudes of sea level, 4000 feet, 8000 feet and 12,000 feet for various gross weights and outside air temperatures. Hover endurance can be determined if gross weight and fuel loading are known.

EXAMPLE: Determine the fuel flow and endurance when hovering OGE at 4000 feet, +7.1°C (standard day) in a 12,700 pound gross weight helicopter, twin engine operation with a fuel loading of 2025 pounds.

Solution:

a. Enter figure 11-6 at 12,700 pound gross weight. Move right to 4000 feet pressure altitude line.

b. Drop down to OAT baseline. Move up, following the trend of the guidelines, to +7.1°C OAT.

c. Move down, read 996 lb/hr fuel flow.

d. Divide total fuel load by fuel flow to calculate hover endurance (2025 ÷ 996 = 2.03 hours).

MAXIMUM ENDURANCE — TWO ENGINE OPERATION

OAT COLDER THAN -10°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

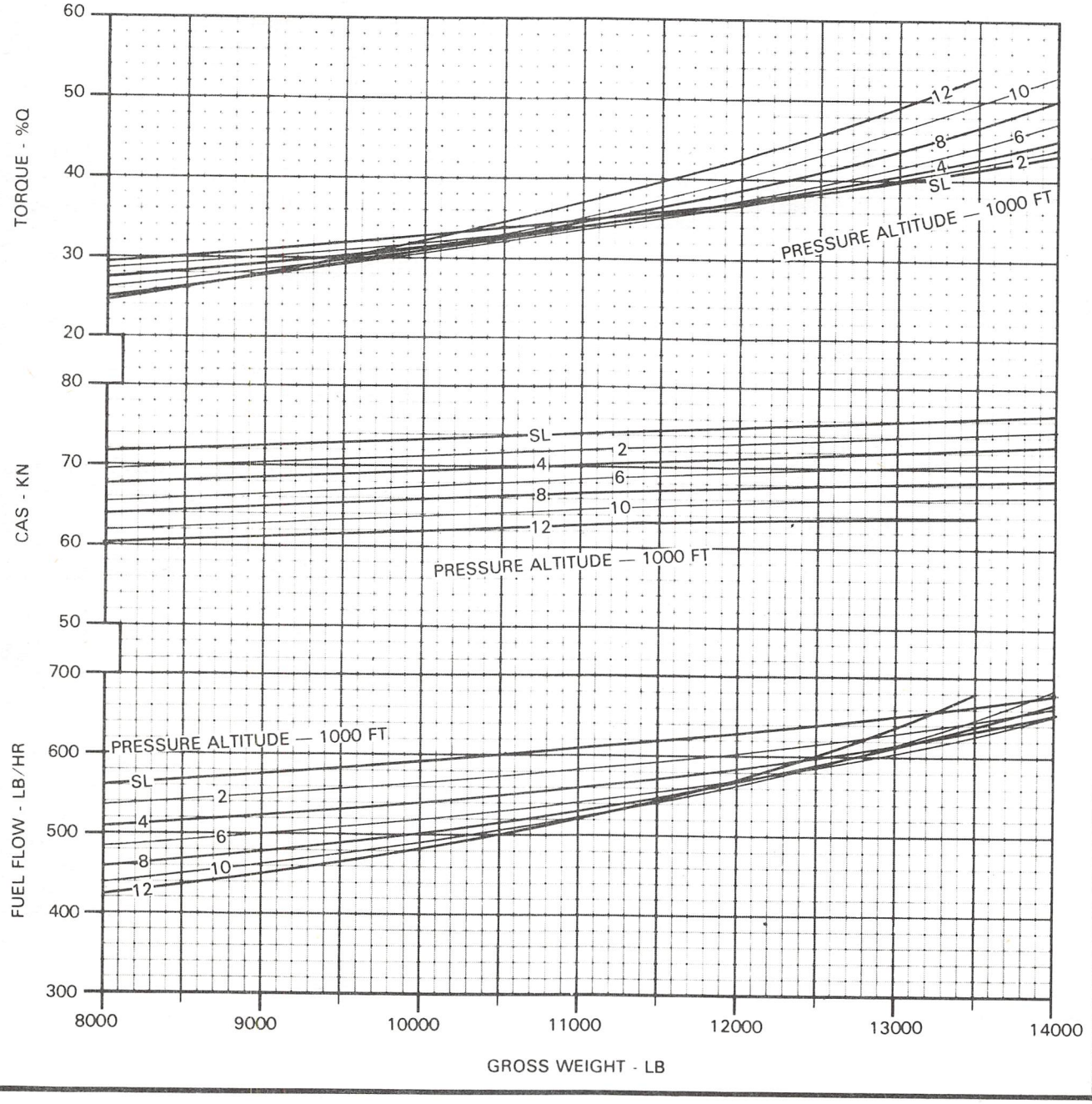


Figure 11-15. Maximum endurance chart (Sheet 1 of 4)

MAXIMUM ENDURANCE — TWO ENGINE OPERATION

OAT BETWEEN -10°C AND +10°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

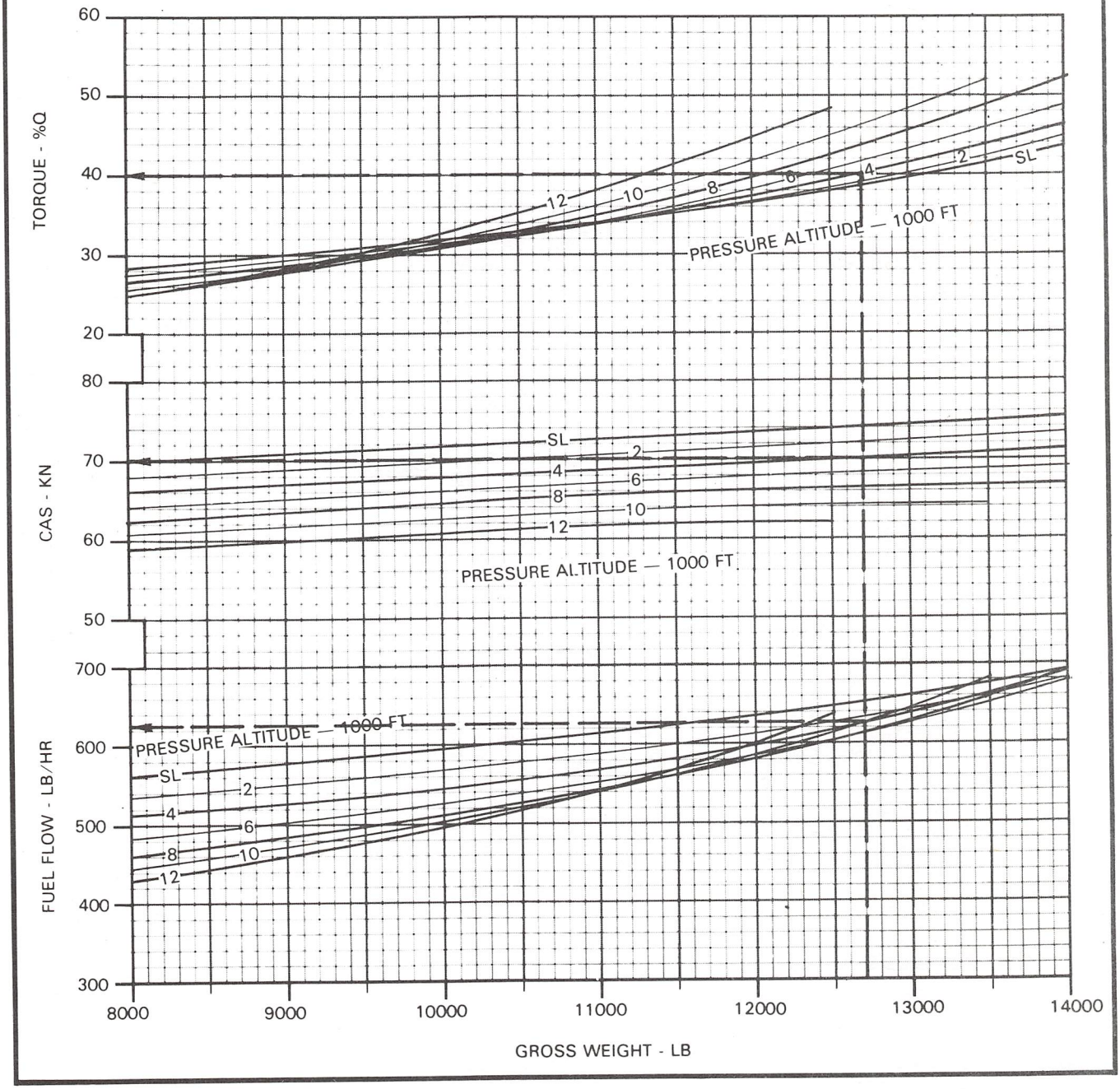


Figure 11-15. Maximum endurance chart (Sheet 2 of 4)

MAXIMUM ENDURANCE — TWO ENGINE OPERATION

OAT BETWEEN +10° AND +25°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

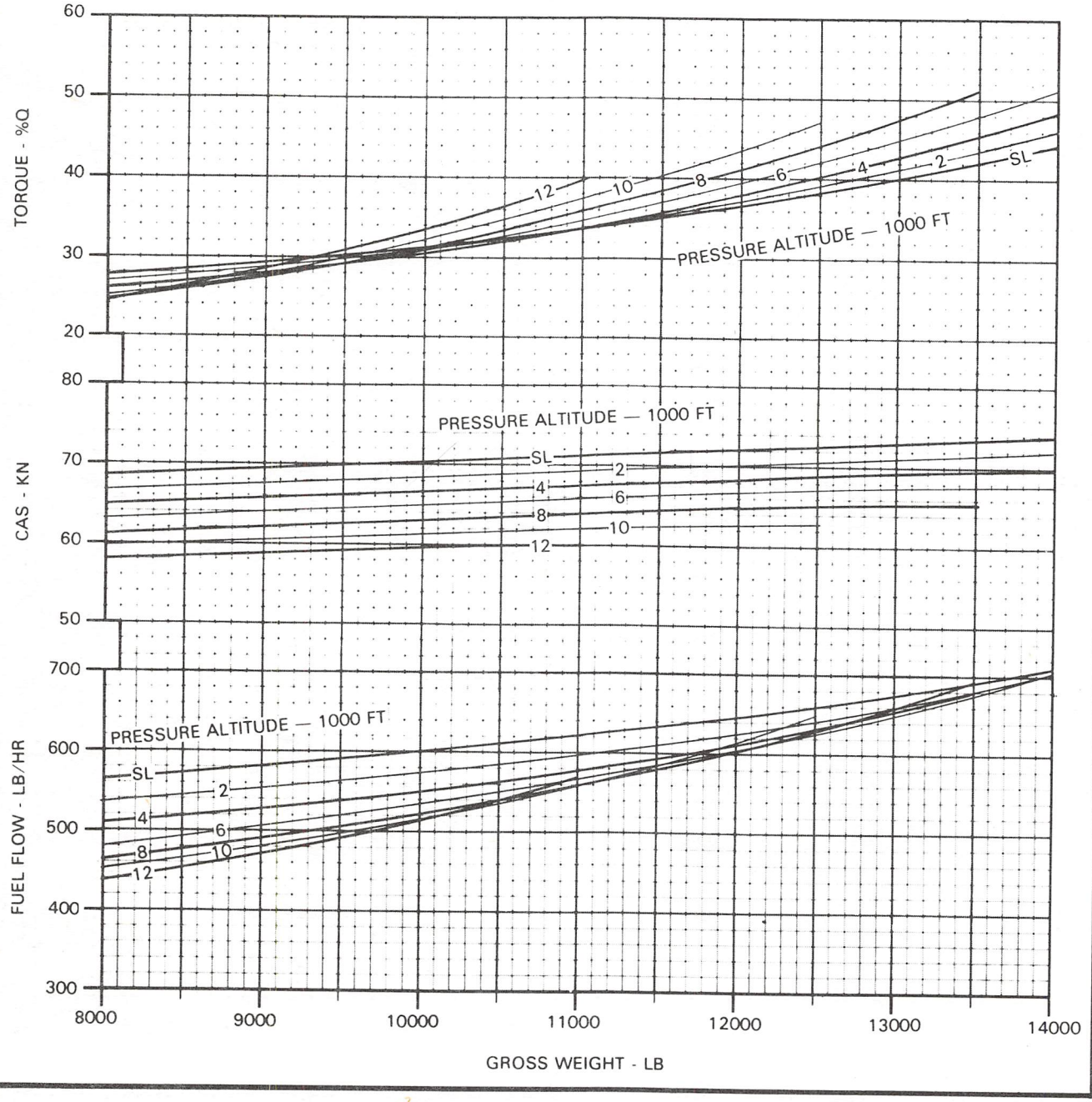


Figure 11-15. Maximum endurance chart (Sheet 3 of 4)

MAXIMUM ENDURANCE — TWO ENGINE OPERATION

OAT HOTTER THAN +25°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

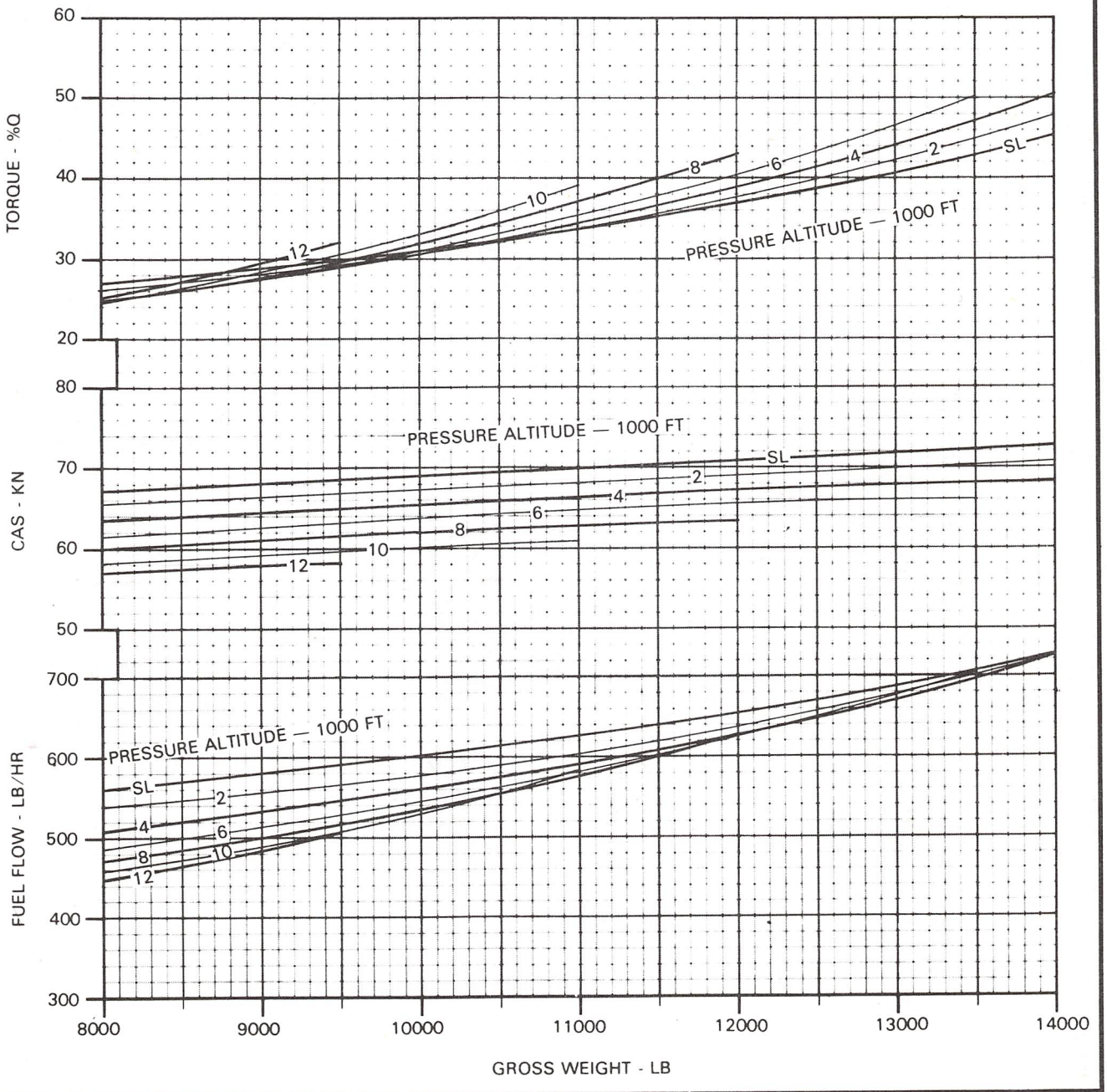


Figure 11-15. Maximum endurance chart (Sheet 4 of 4)

HOVERING ENDURANCE - TWO ENGINE OPERATION

ALL CONFIGURATIONS

OUT OF GROUND EFFECT

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

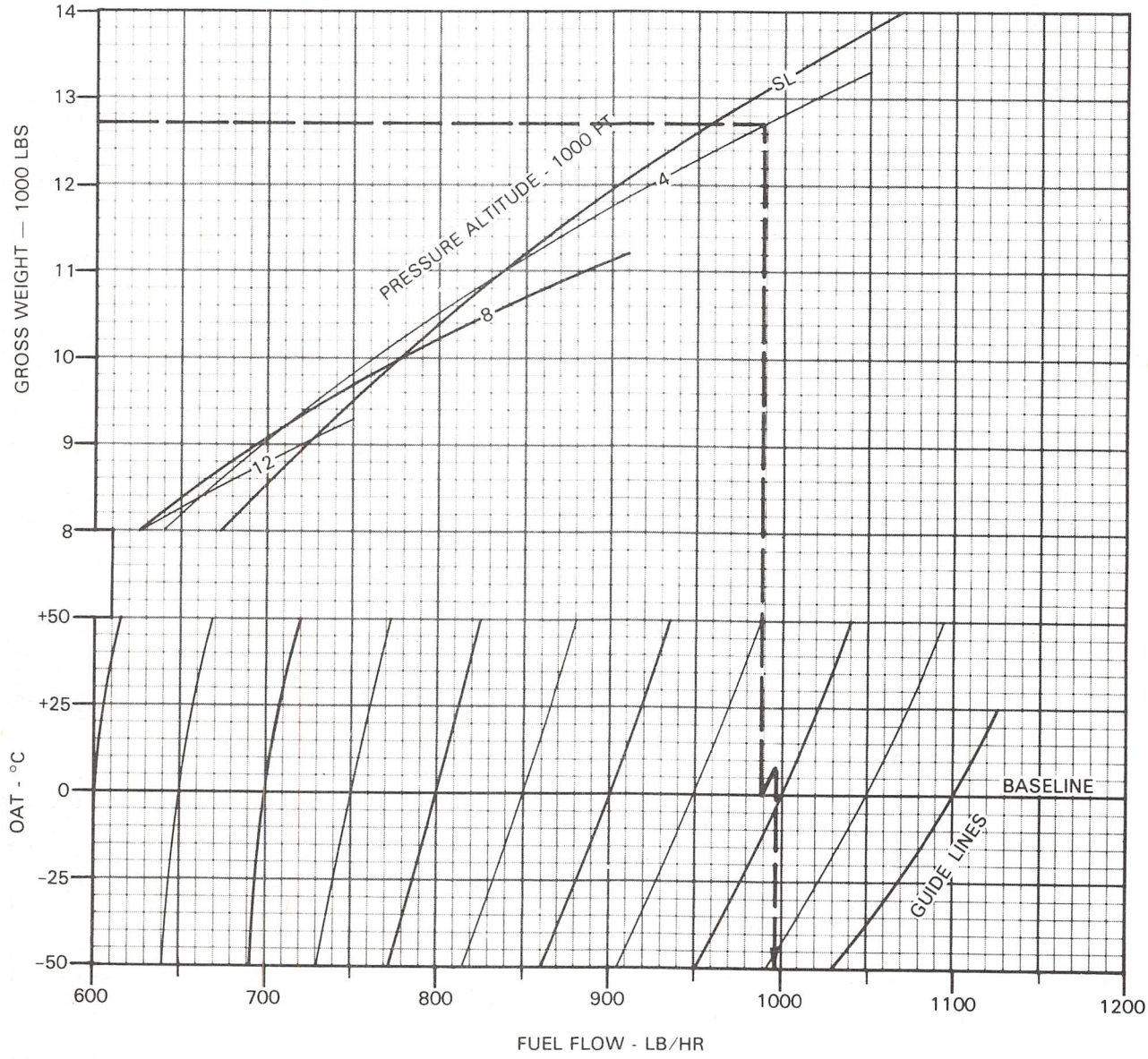


Figure 11-16. Hover endurance chart

PART 6 — EMERGENCY OPERATION

SINGLE ENGINE MAXIMUM GROSS WEIGHT FOR HOVERING.

Refer to maximum gross weight for hovering text in part 2 (page 10).

SINGLE ENGINE CLIMB PERFORMANCE.

Refer to climb performance text in part 3 (page 15).

SINGLE ENGINE BEST RANGE.

Refer to best range text in part 4 (page 18).

SINGLE ENGINE RANGE.

Refer to range text in part 4 (page 18).

SINGLE ENGINE MAXIMUM ENDURANCE.

Refer to maximum endurance text in part 5 (page 49).

SINGLE ENGINE SERVICE CEILING.

Refer to service ceiling text in part 3 (page 15).

ABILITY TO MAINTAIN FLIGHT ON ONE ENGINE.

This chart (figure 11-24) presents both 8 TOW missile and clean configurations for lines of gross weight as a function of pressure altitude and calibrated airspeed at outside air temperatures of -20°C, 0°C, +20°C and +40°C.

EXAMPLE: Determine the minimum and the maximum airspeed (in terms of KCAS) for a 12,000 pound helicopter, 8 TOW missile configuration, with one engine inoperative at an altitude of 2000 feet, standard day (+11°C).

Solution:

Interpolation between 0°C OAT and +20°C OAT charts is necessary in order to satisfy the standard day condition.

a. Enter figure 11-24 at 2000 feet pressure altitude for both 0°C and +20°C charts. Read minimum and maximum calibrated airspeeds for each temperature:

	0°C OAT	+20°C OAT
Minimum	38 KCAS	50 KCAS
Maximum	98 KCAS	80 KCAS

b. Divide actual temperature by the Δ temperature to obtain interpolation factor (+11°C +20°C = 55%).

c. Interpolate for +11°C minimum and maximum calibrated airspeeds using 55% interpolation factor.

1. Minimum airspeed at 11°C, 2000 ft = 44.6 KCAS

2. Maximum airspeed at 11°C, 2000 ft = 88.1 KCAS.

MINIMUM AIRSPEED FOR FLIGHT WITH ONE ENGINE.

The minimum airspeed for flight with one engine chart (figure 11-25) presents gross weight as a function of calibrated airspeed and outside air temperature for sea level and out of ground effect condition.

EXAMPLE: Determine the minimum airspeed for a 12,000 pound helicopter operating on one engine at sea level, +11°C.

Solution:

a. Enter figure 11-25 at 12,000 pound gross weight. Move left and interpolate between +10°C and +15°C for +11°C.

b. Drop down and read 38 KCAS.

SINGLE ENGINE MAXIMUM GROSS WEIGHT FOR HOVERING
(EFFECT OF SKID HEIGHT ABOVE GROUND)

INTERMEDIATE RATED POWER

ZERO WIND CONDITION

100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

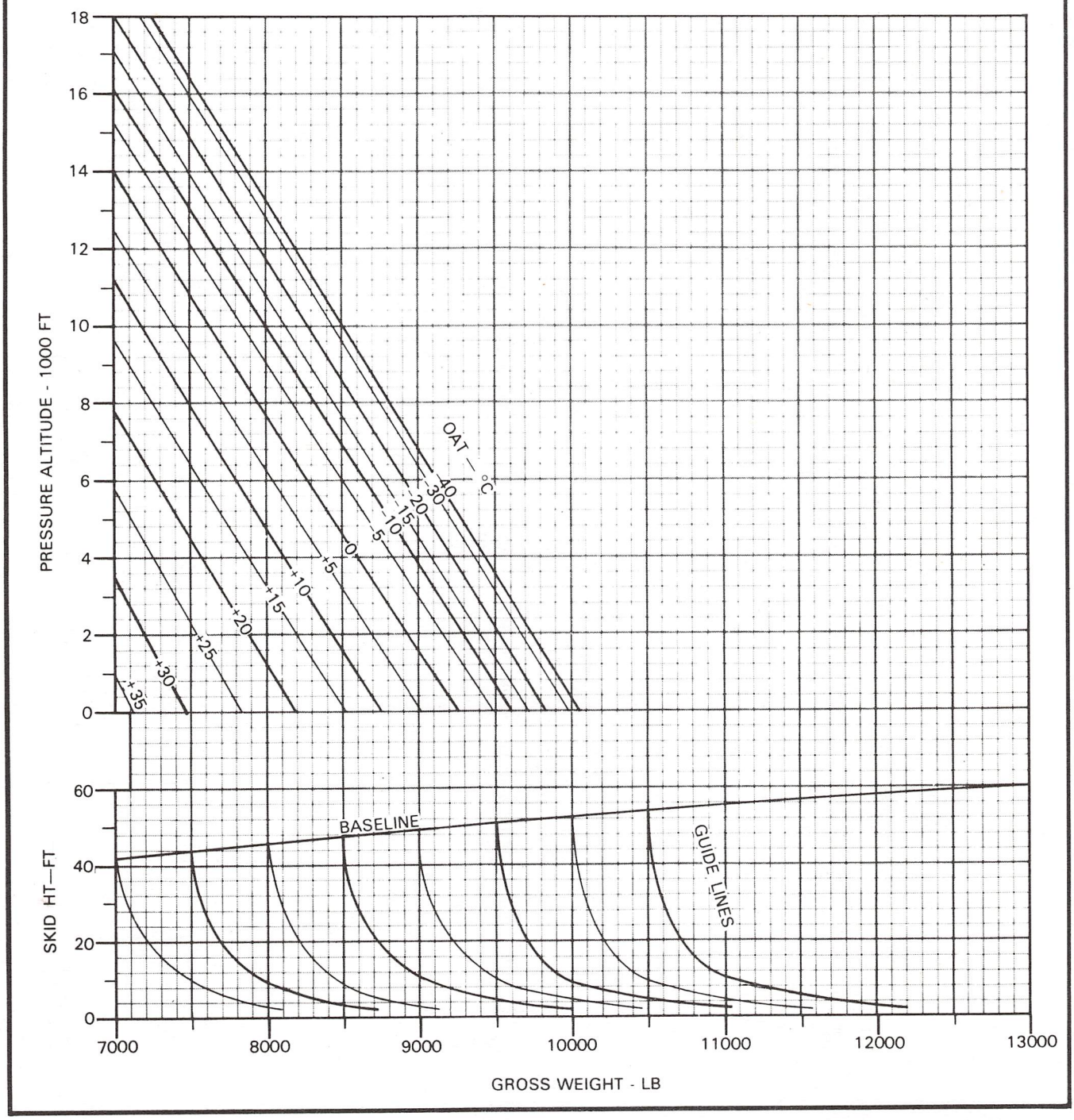


Figure 11-17. Single engine maximum gross weight for hovering chart (Sheet 1 of 2)

SINGLE ENGINE MAXIMUM GROSS WEIGHT FOR HOVERING
(EFFECT OF HEADWIND)

INTERMEDIATE RATED POWER

OUT OF GROUND EFFECT

100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

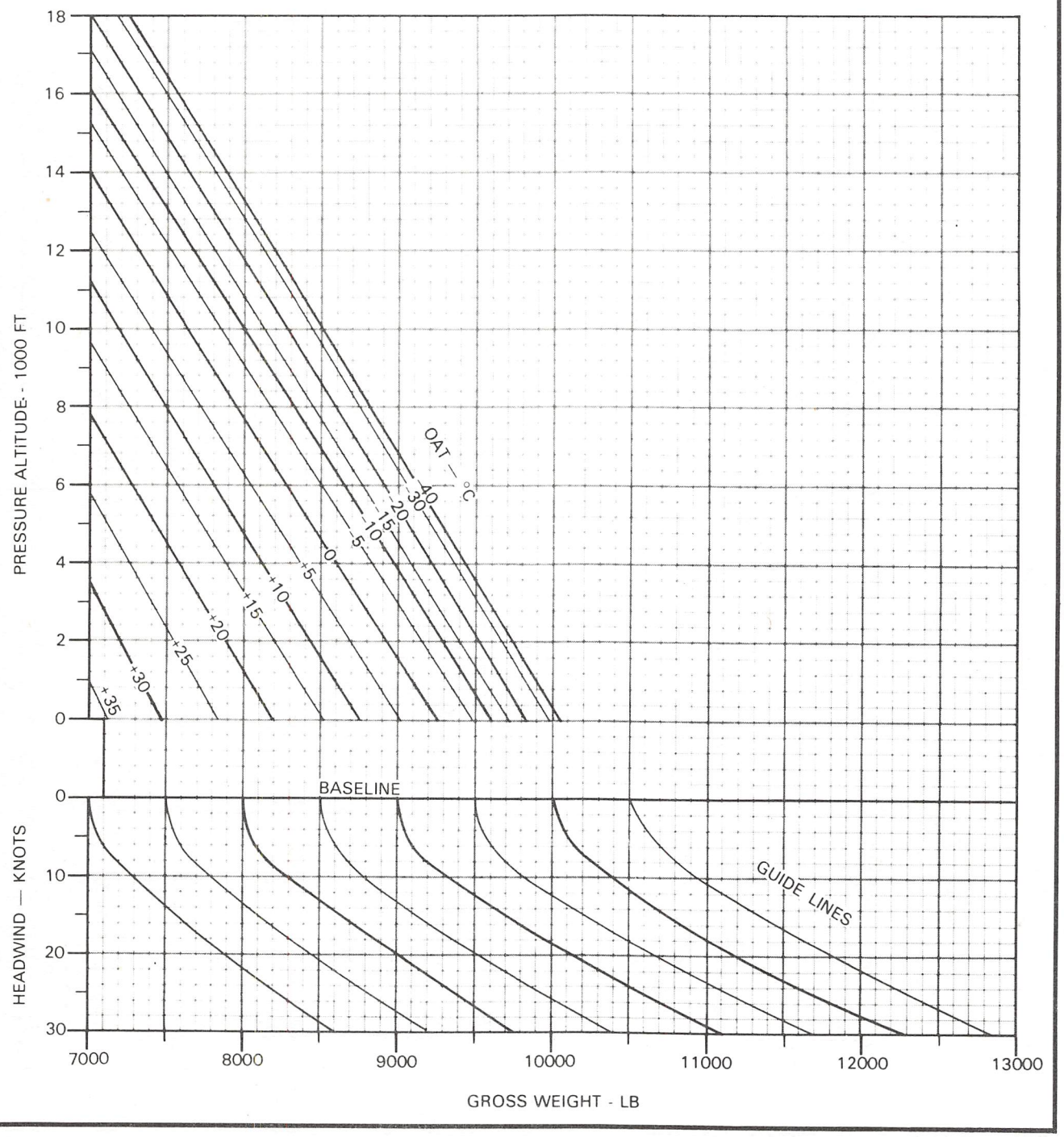


Figure 11-17. Single engine maximum gross weight for hovering chart (Sheet 2 of 2)

SINGLE ENGINE CLIMB PERFORMANCE

INTERMEDIATE RATED POWER

ALL CONFIGURATIONS

100% ENGINE RPM

65 KIAS

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

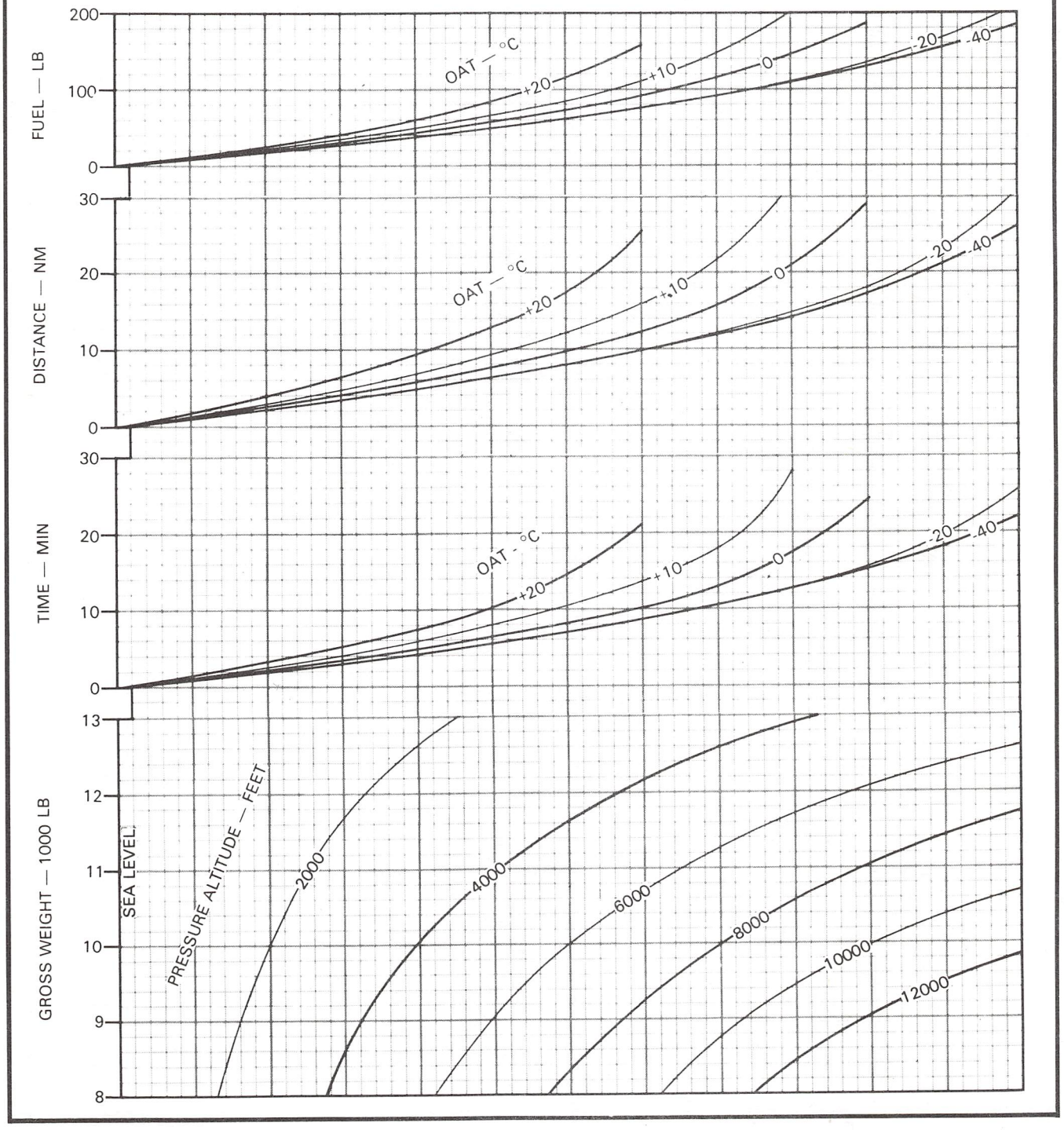


Figure 11-18. Single engine climb performance chart

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT COLDER THAN -10°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

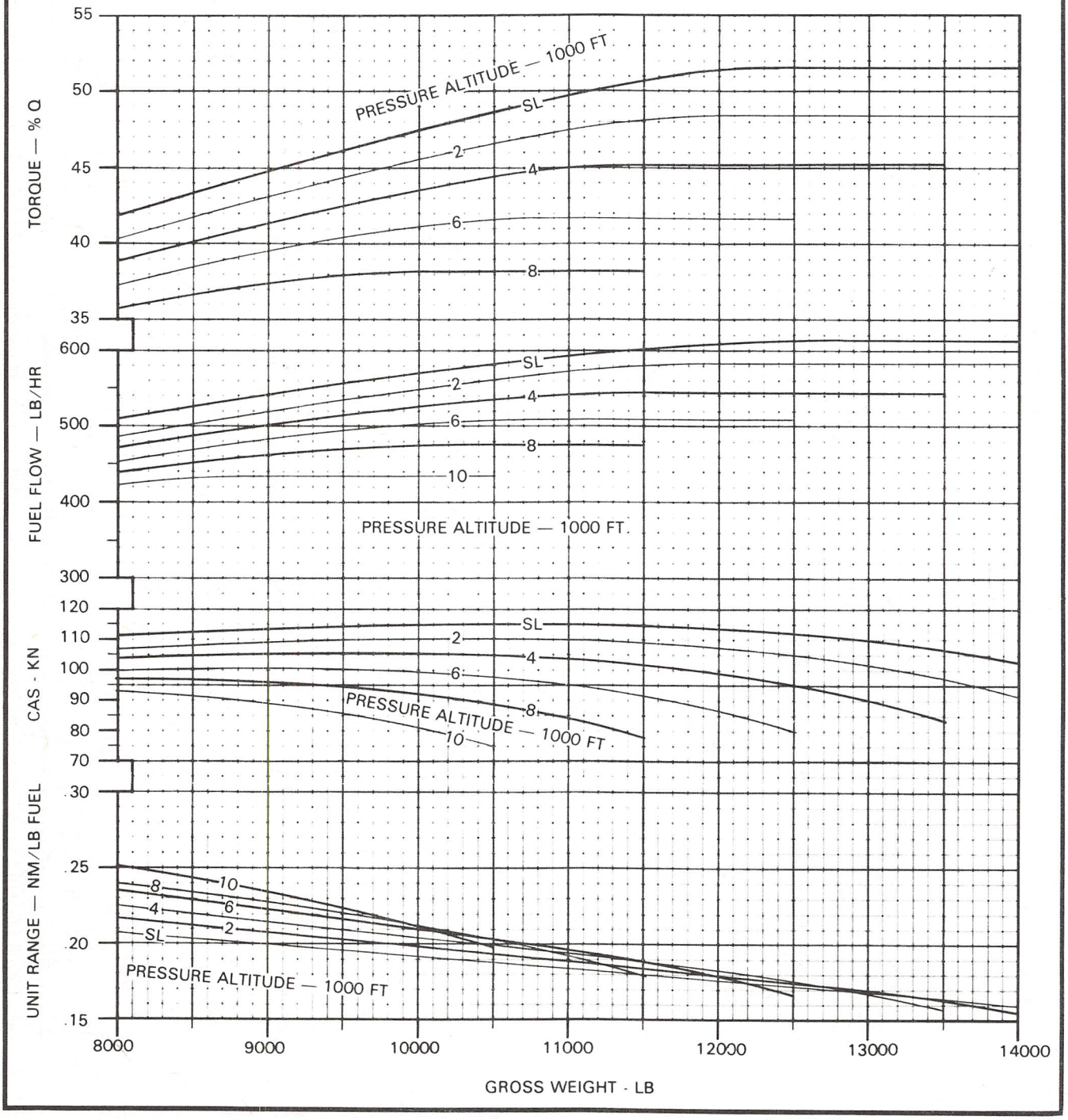


Figure 11-19. Single engine best range (8 TOW missile configuration) chart (Sheet 1 of 4)

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT BETWEEN -10°C AND +10°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

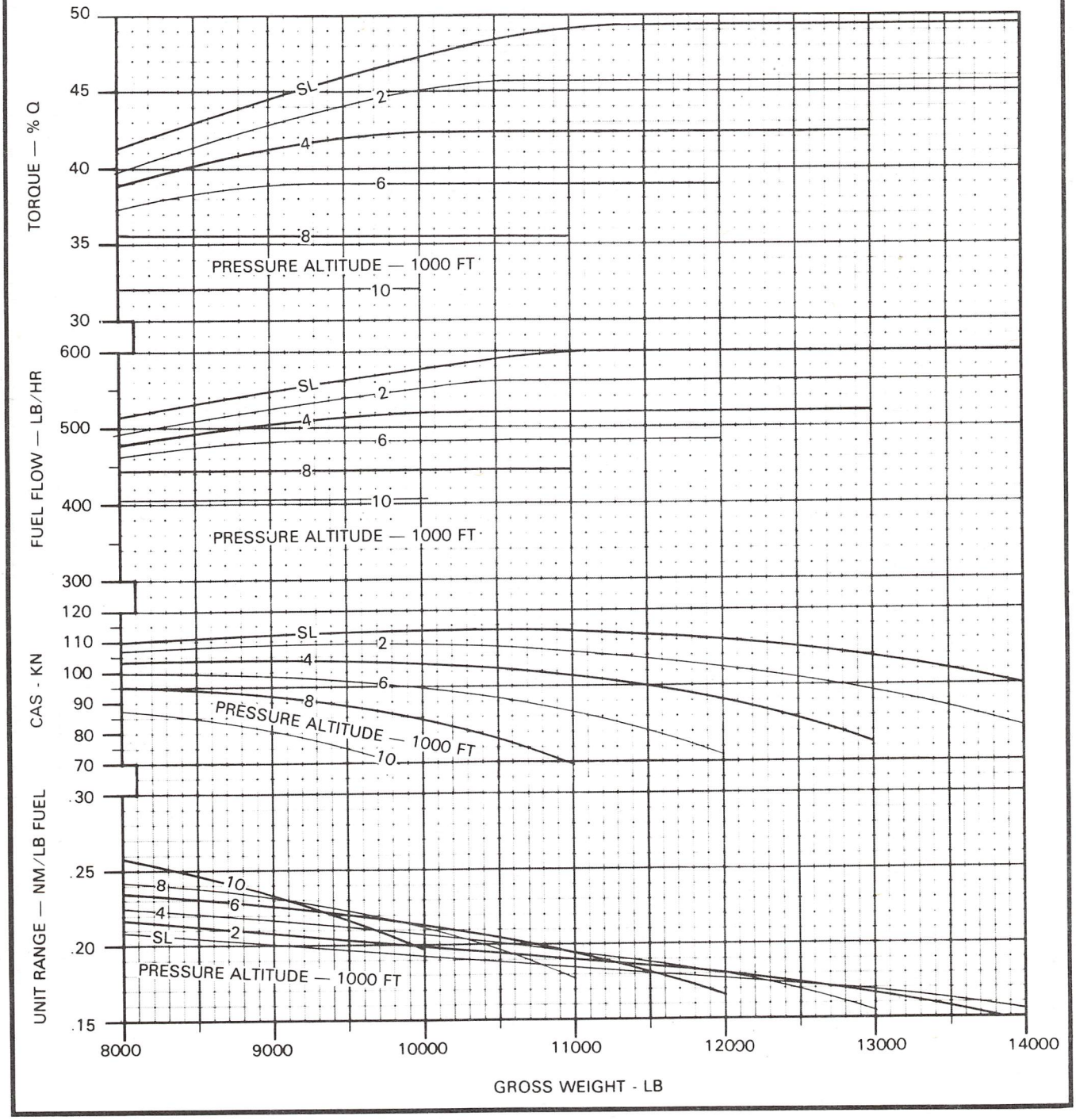


Figure 11-19. Single engine best range (8 TOW missile configuration) chart (Sheet 2 of 4)

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT BETWEEN +10°C AND +25°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

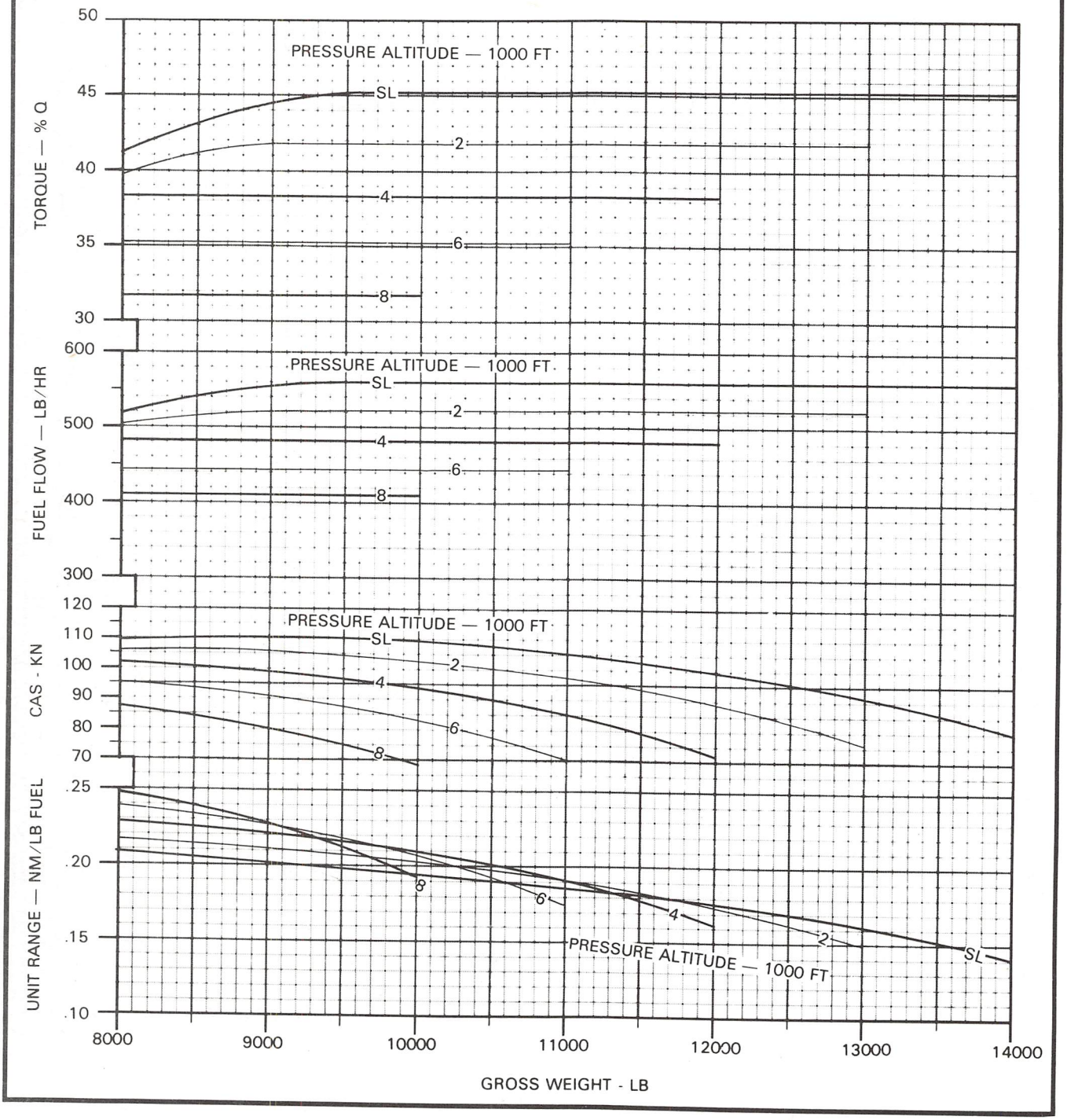


Figure 11-19. Single engine best range (8 TOW missile configuration) chart (Sheet 3 of 4)

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT HOTTER THAN +25°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

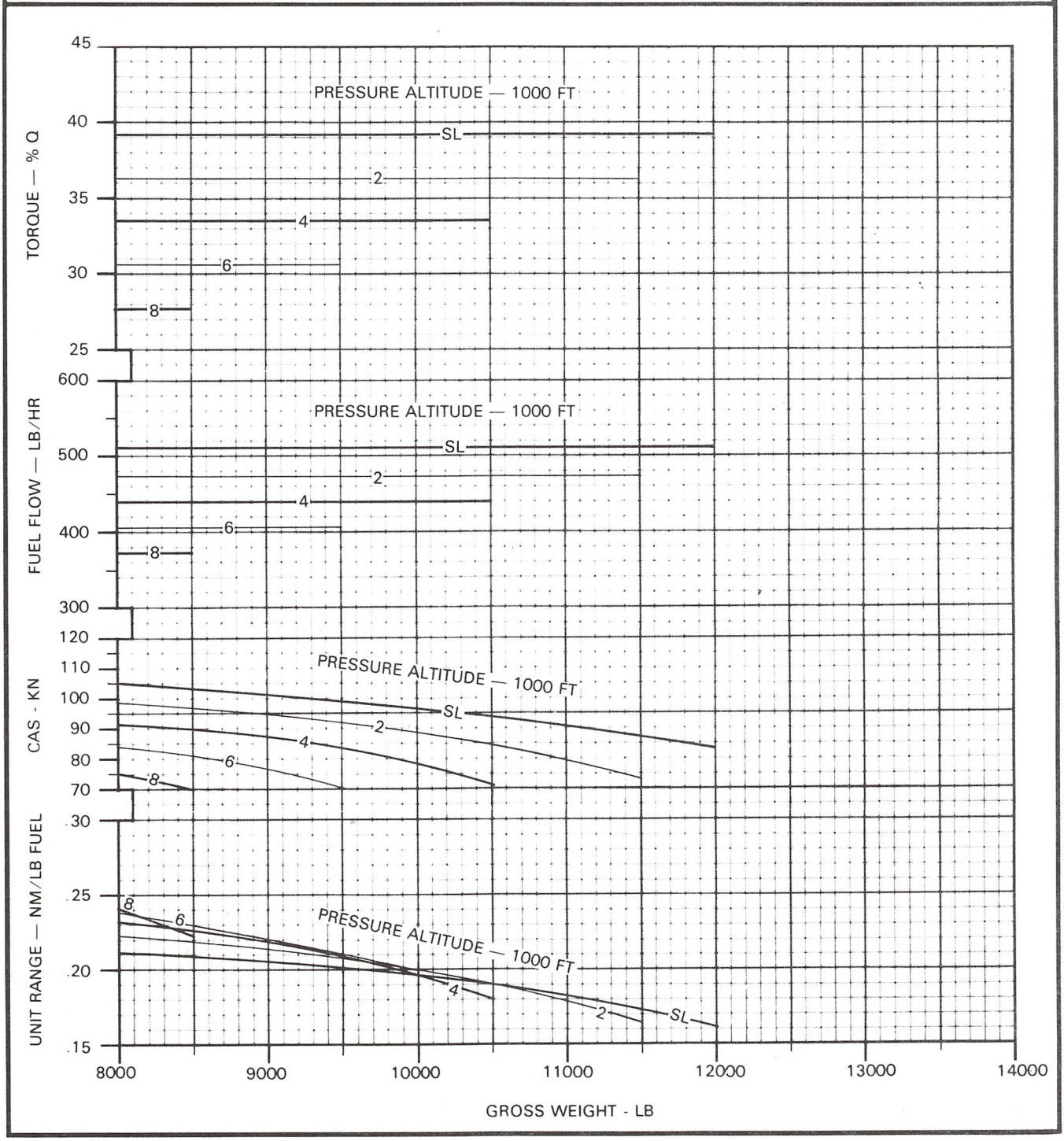


Figure 11-19. Single engine best range (8 TOW missile configuration) chart (Sheet 4 of 4)

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT COLDER THAN -10°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

CLEAN CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

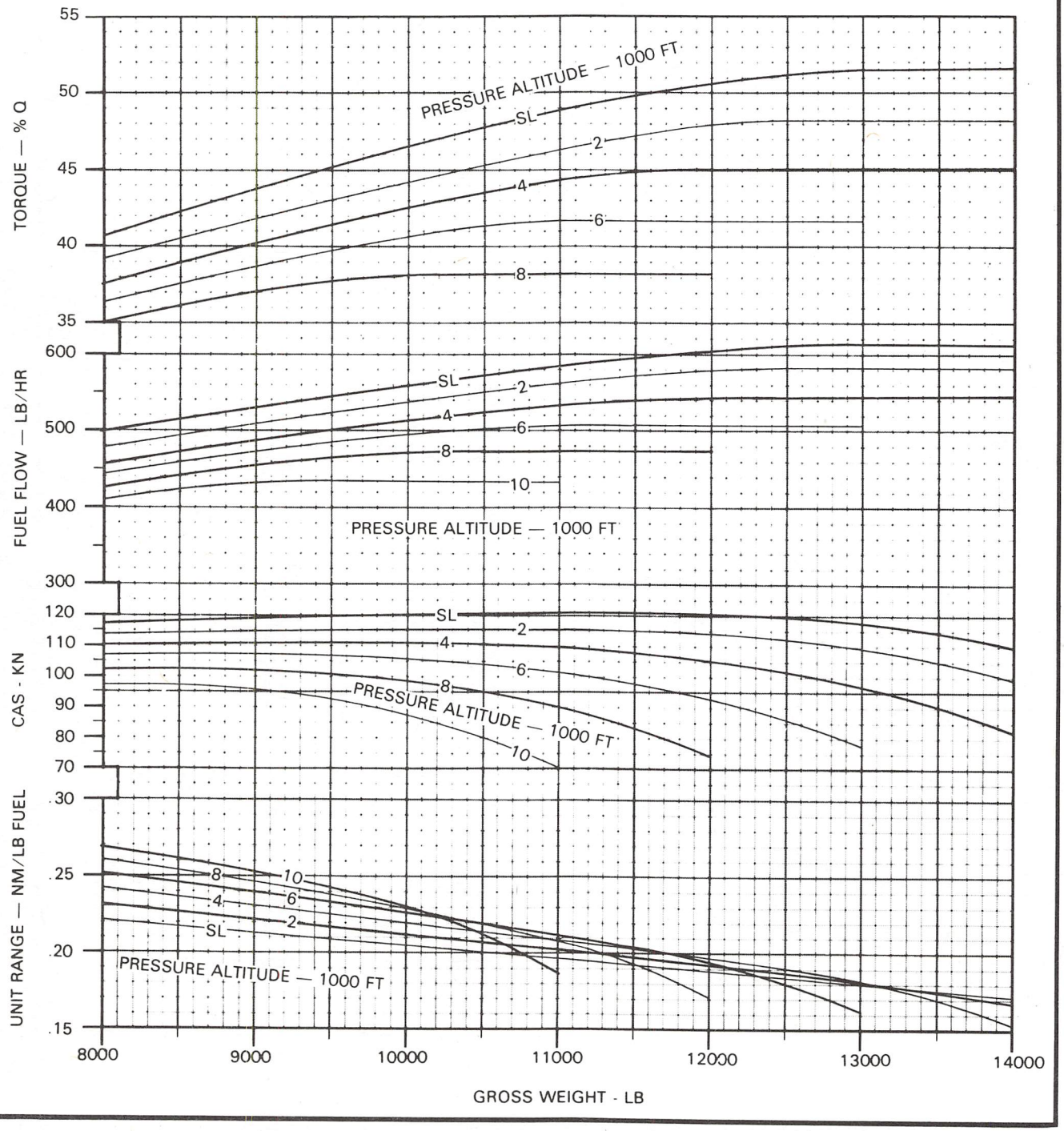


Figure 11-20. Single engine best range (clean configuration) chart (Sheet 1 of 4)

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT BETWEEN -10°C AND +10°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

CLEAN CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

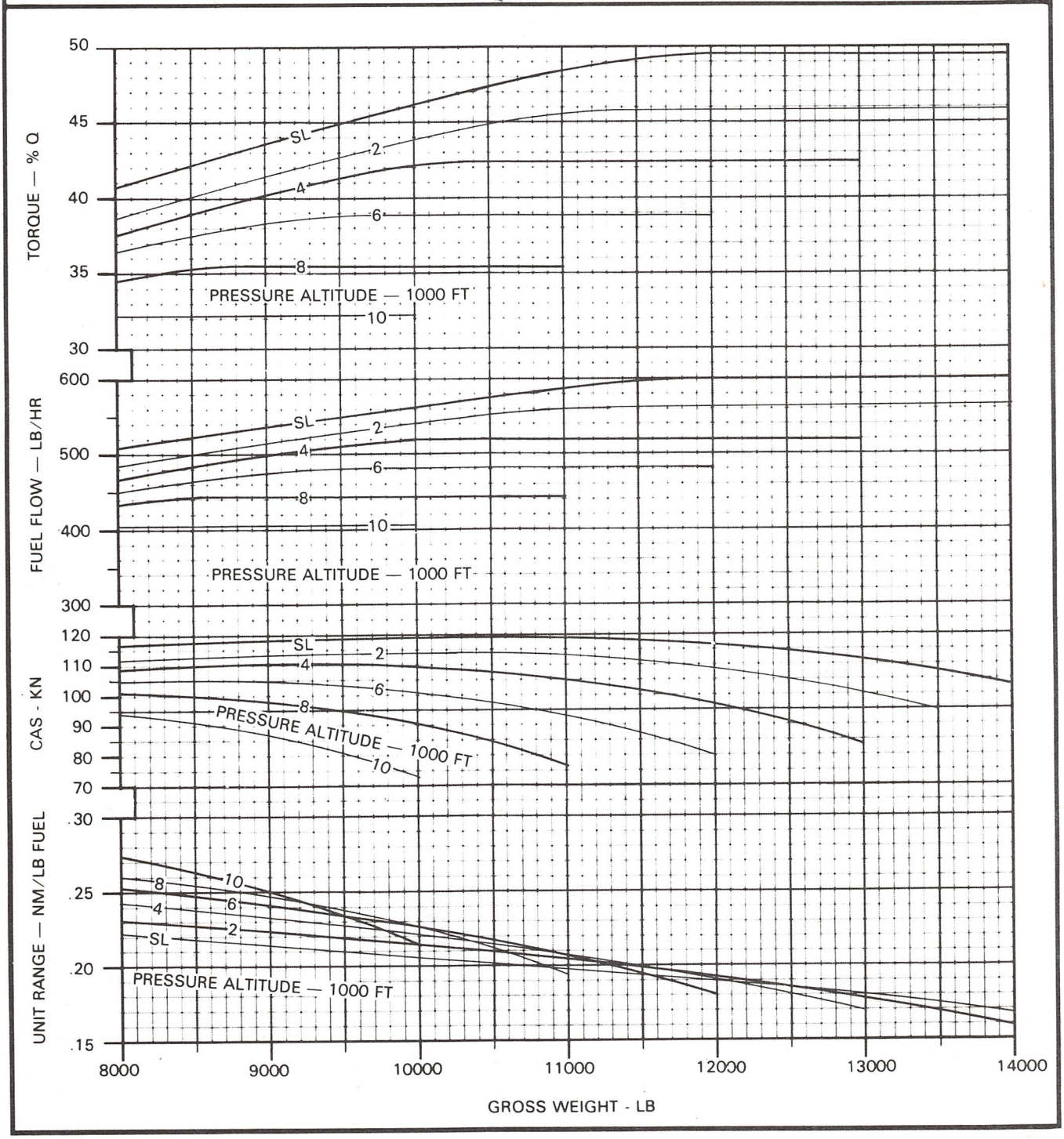


Figure 11-20. Single engine best range (clean configuration) chart (Sheet 2 of 4)

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT BETWEEN +10°C AND +25°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

CLEAN CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

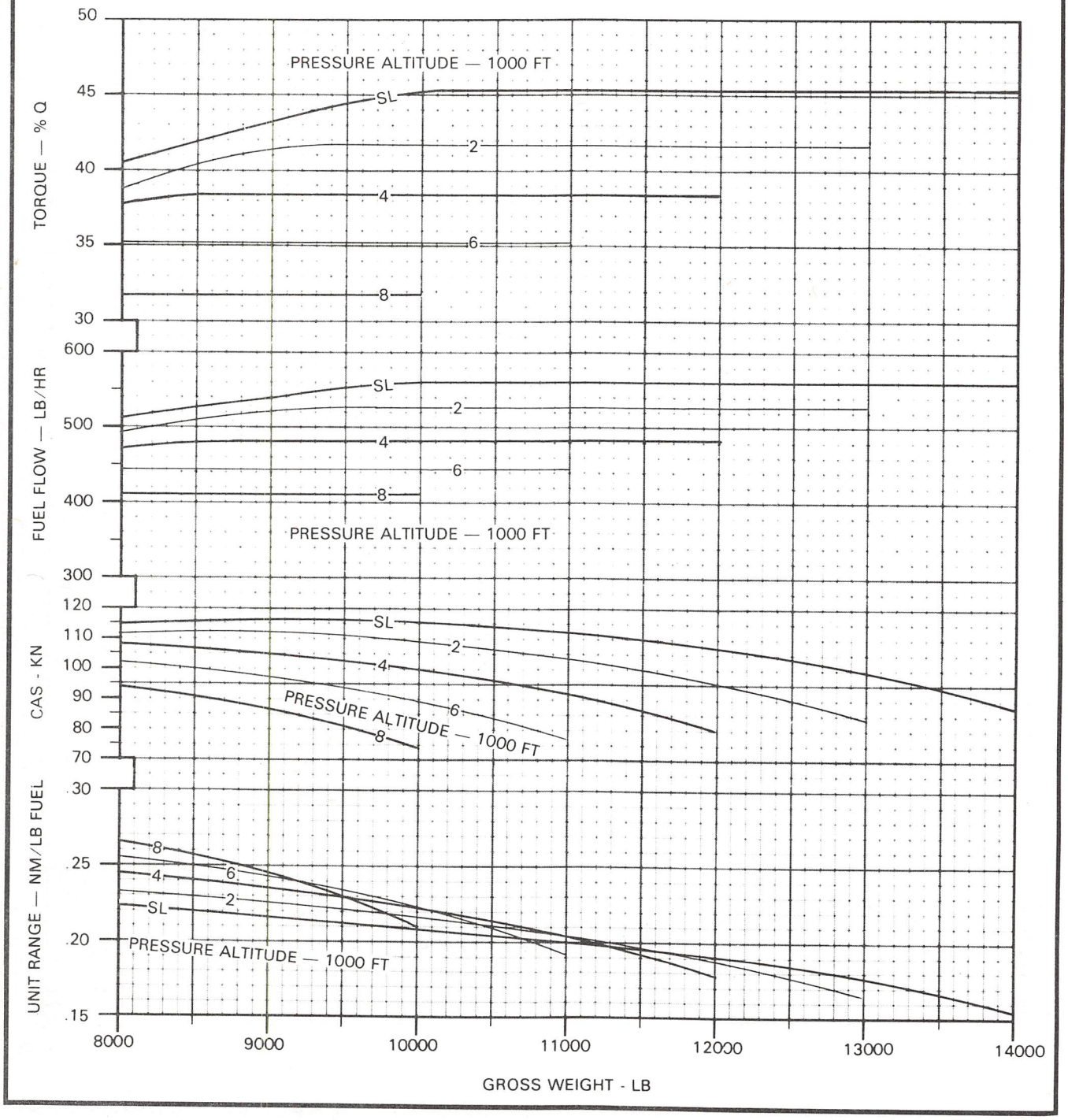


Figure 11-20. Single engine best range (clean configuration) chart (Sheet 3 of 4)

SINGLE ENGINE BEST RANGE

(AT LONG RANGE CRUISE)

OAT HOTTER THAN +25°C

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

CLEAN CONFIGURATION
100% ENGINE RPM

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

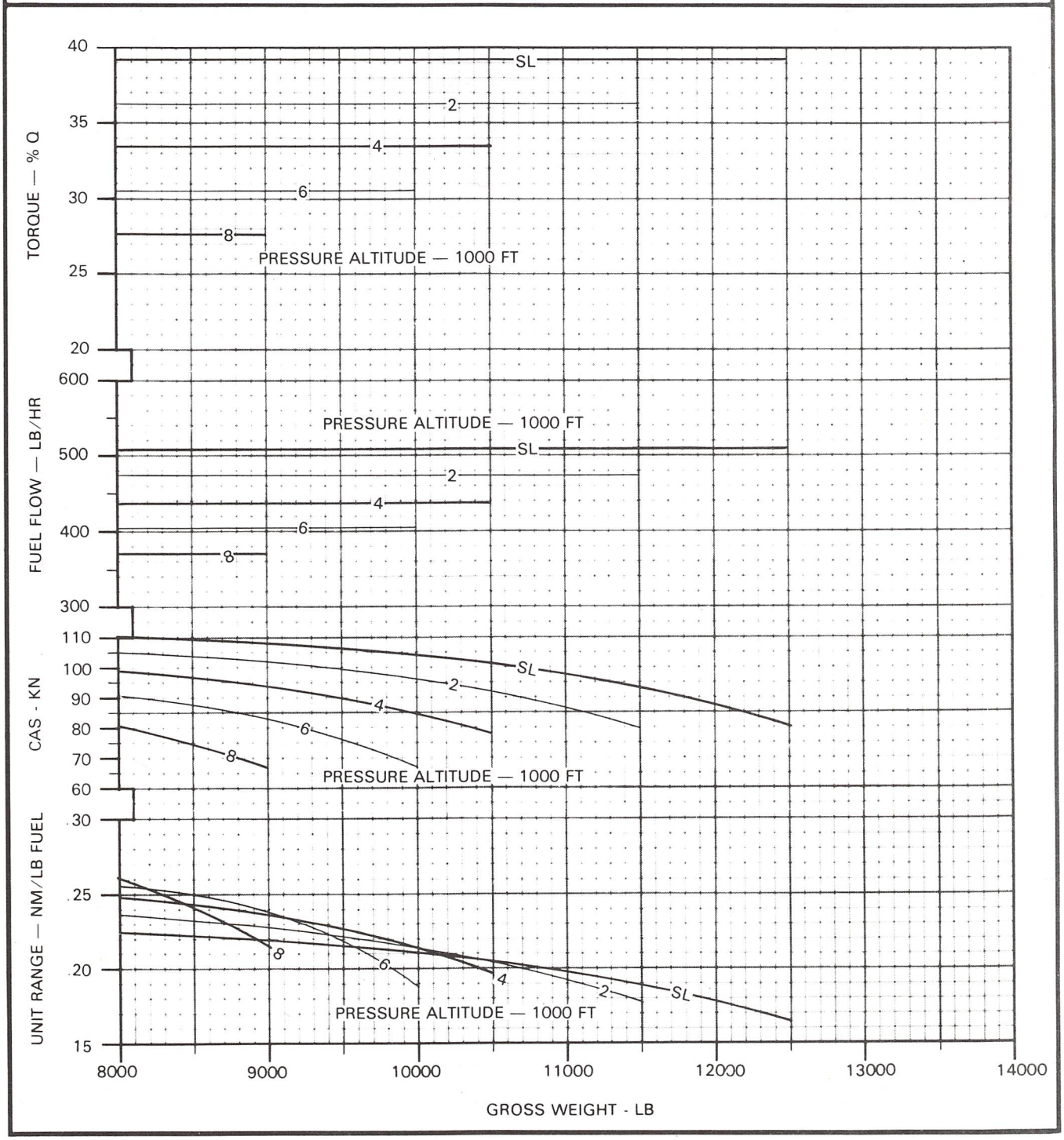


Figure 11-20. Single engine best range (clean configuration) chart (Sheet 4 of 4)

SINGLE ENGINE RANGE CHART

OAT COLDER THAN -10°C

INTERMEDIATE RATED POWER
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATION		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	51.5%Q	615 LB/HR
2000	48.4	585
4000	45.1	546
6000	41.7	511
8000	38.3	476
10,000	34.9	434
12,000	31.6	399

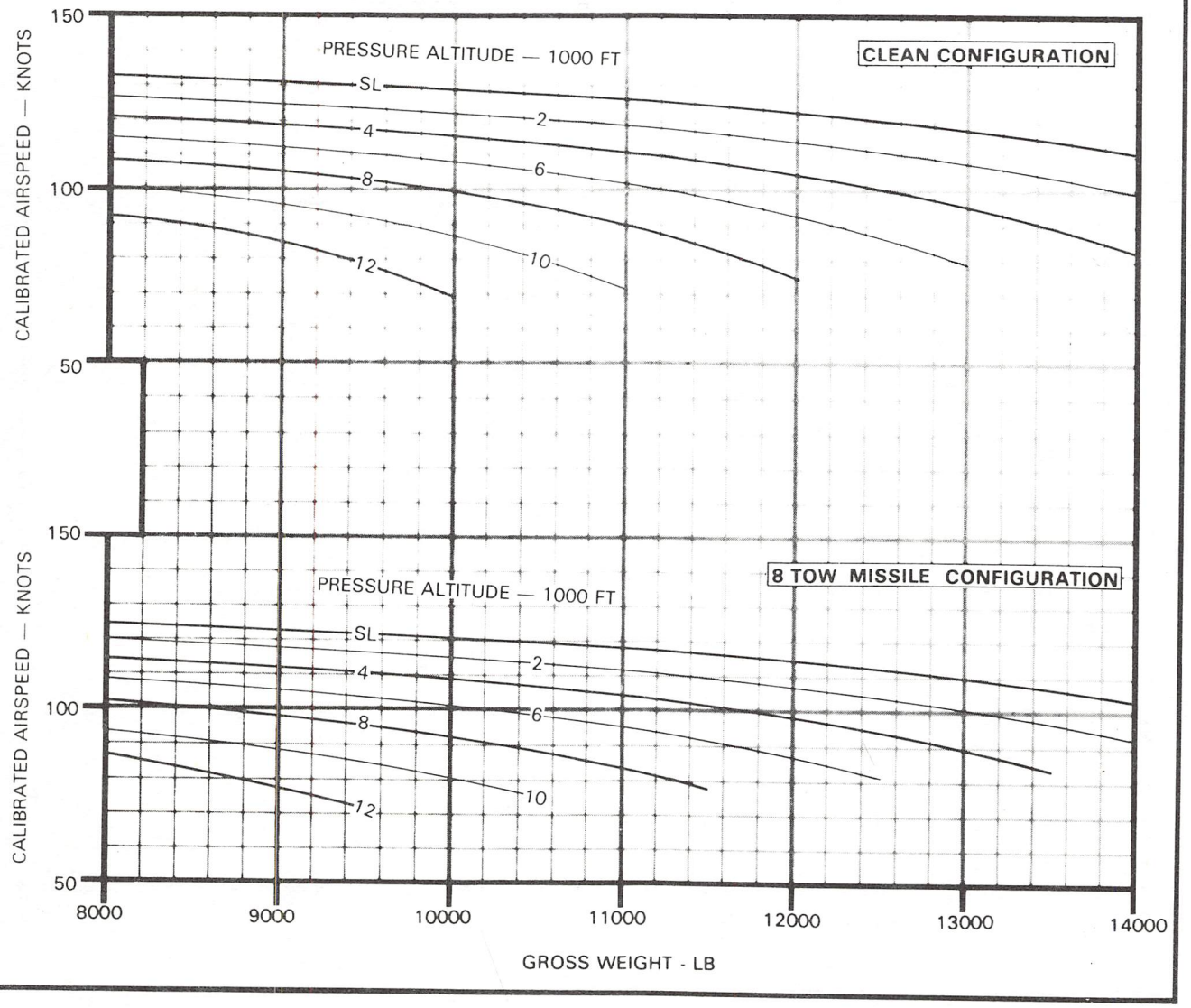


Figure 11-21. Single engine range chart (Sheet 1 of 12)

SINGLE ENGINE RANGE CHART

OAT COLDER THAN -10°C

INTERMEDIATE RATED POWER
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

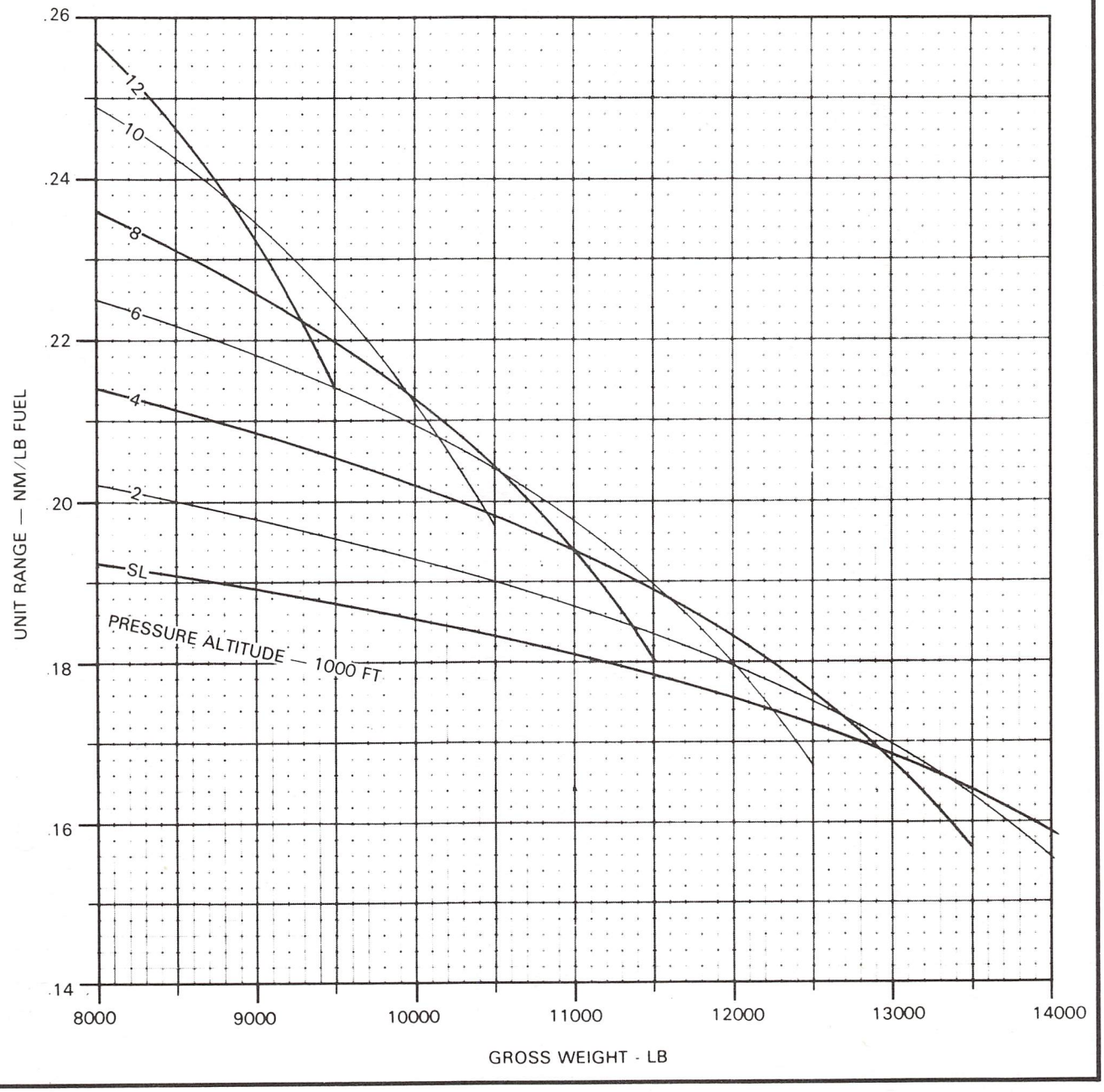


Figure 11-21. Single engine range chart (Sheet 2 of 12)

SINGLE ENGINE RANGE CHART

OAT COLDER THAN -10°C

INTERMEDIATE RATED POWER
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

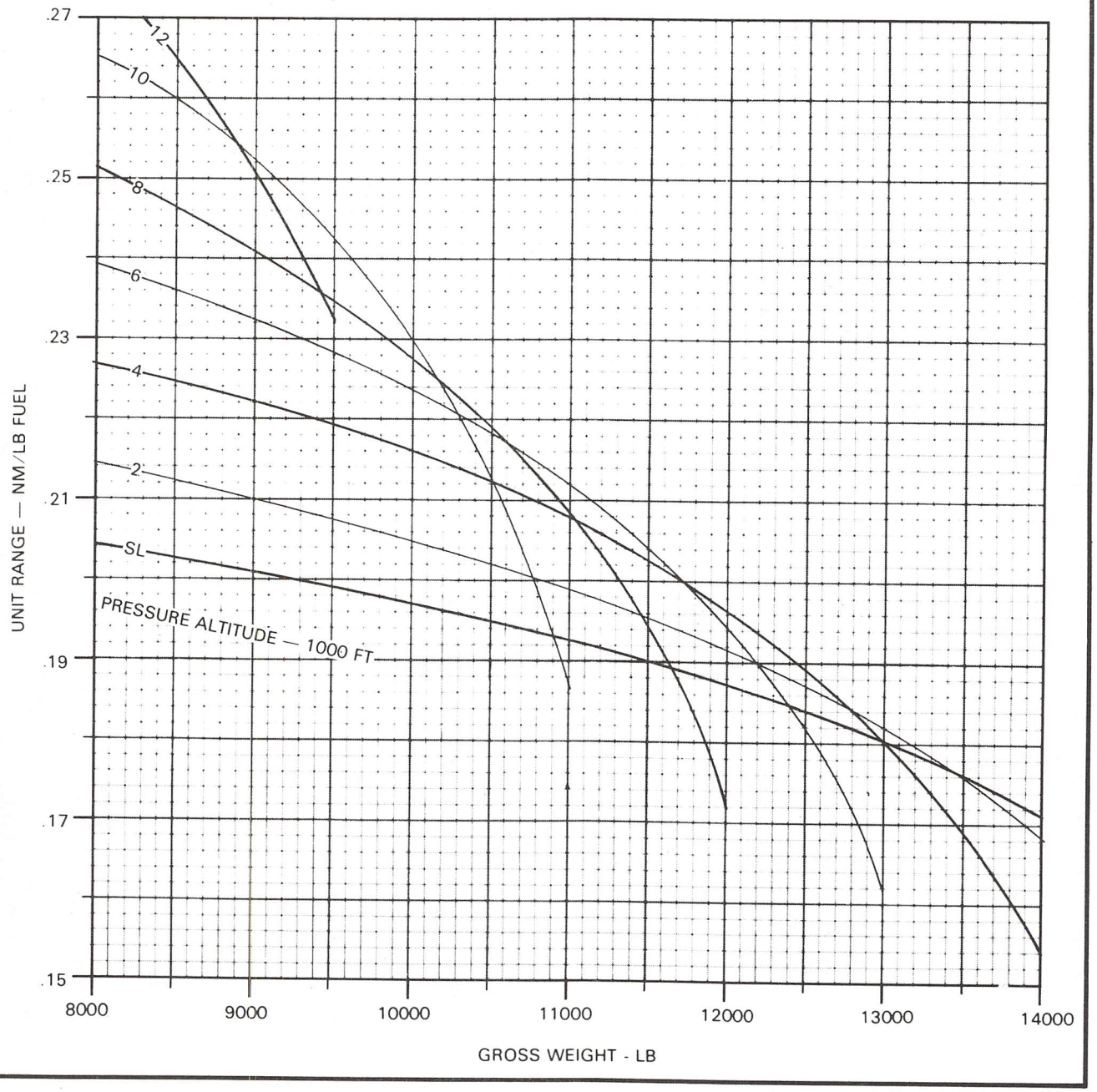


Figure 11-21. Single engine range chart (Sheet 3 of 12)

SINGLE ENGINE RANGE CHART

OAT BETWEEN -10°C AND +10°C

INTERMEDIATE RATED POWER
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATION		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	49.4%Q	600 LB/HR
2000	45.9	563
4000	42.4	521
6000	38.9	483
8000	35.5	446
10,000	32.2	406
12,000	29.0	372

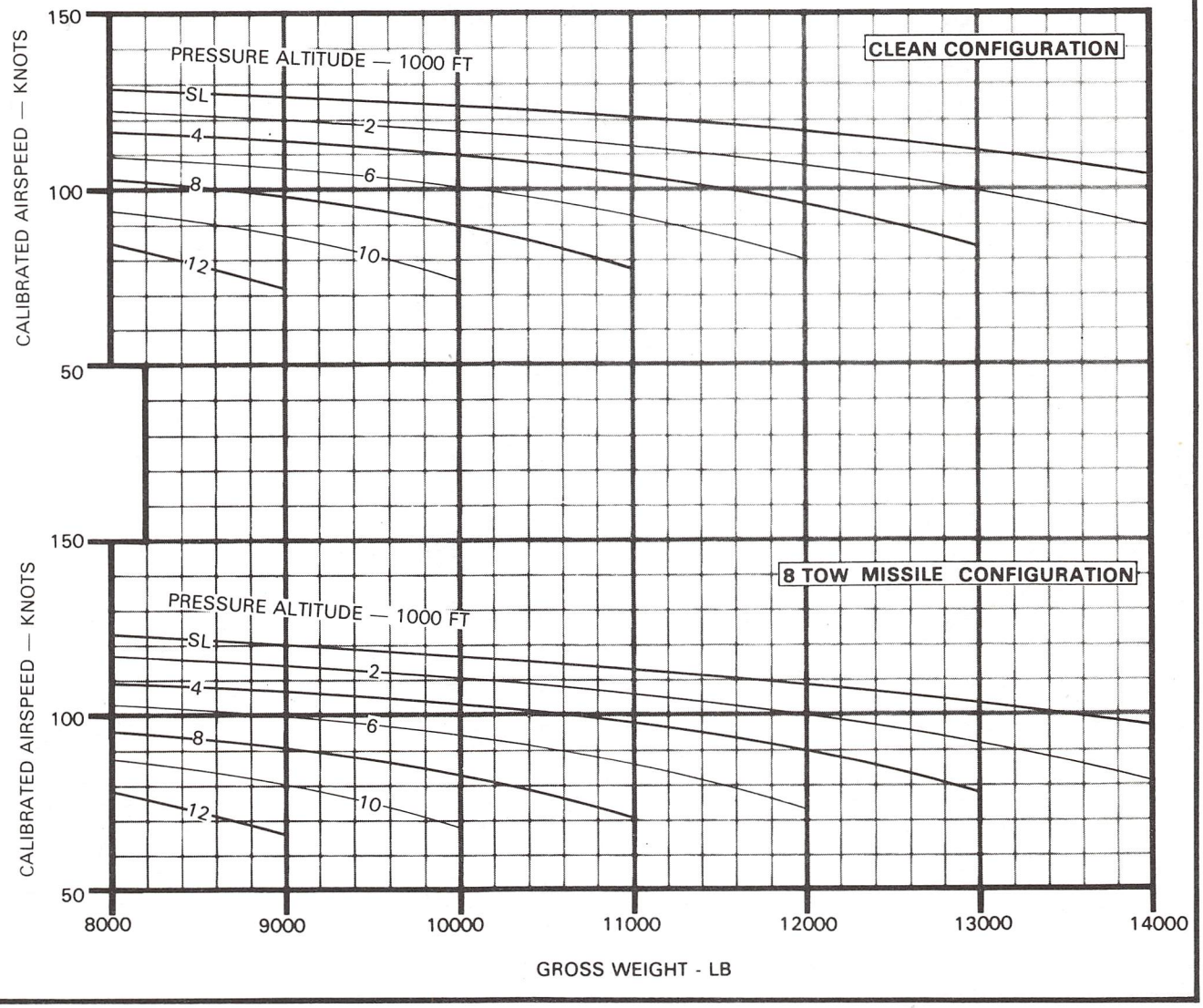


Figure 11-21. Single engine range chart (Sheet 4 of 12)

SINGLE ENGINE RANGE CHART

OAT BETWEEN -10°C AND +10°C

INTERMEDIATE RATED POWER
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

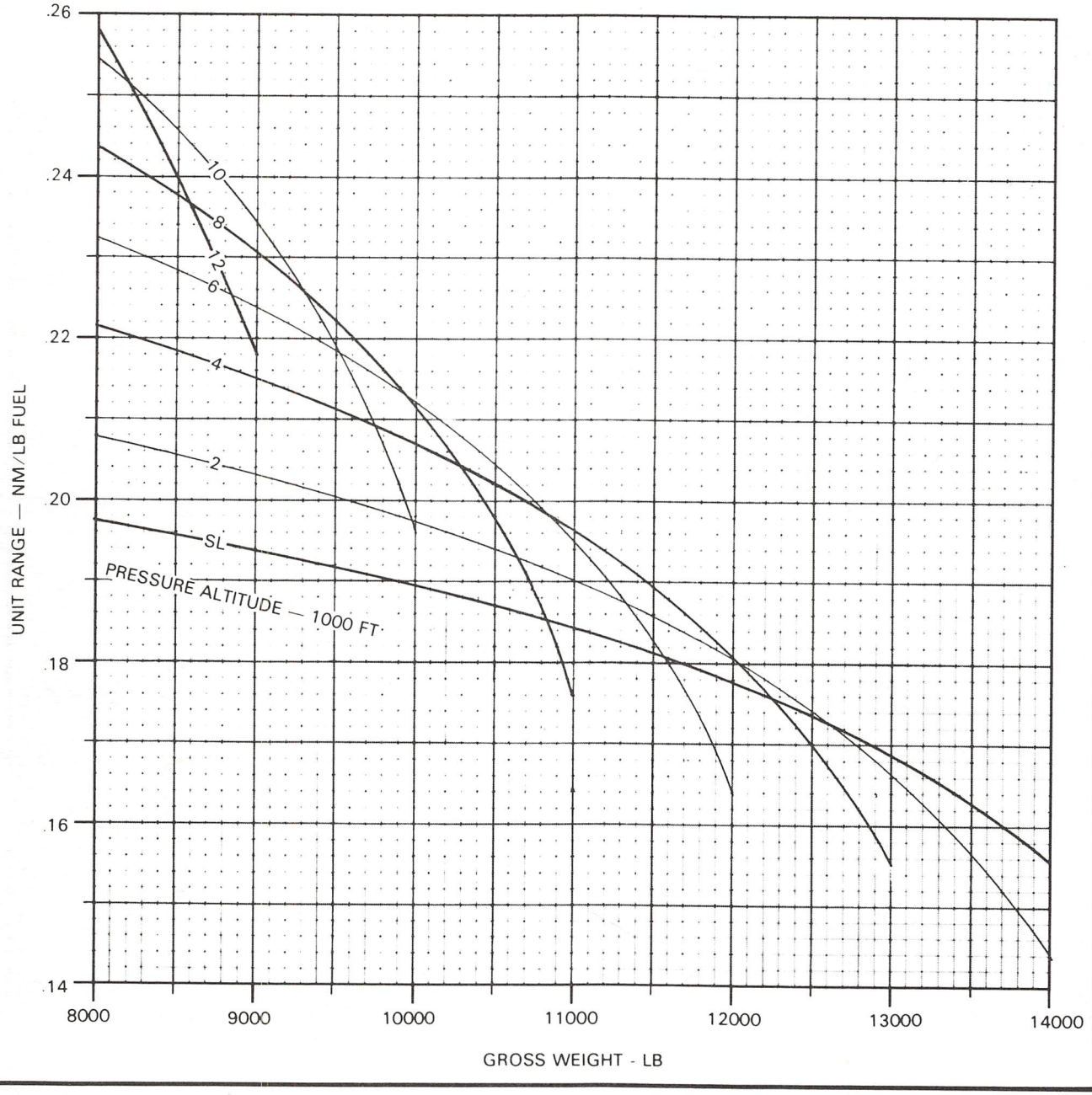


Figure 11-21. Single engine range chart (Sheet 5 of 12)

SINGLE ENGINE RANGE CHART

OAT BETWEEN -10°C AND +10°C

INTERMEDIATE RATED POWER
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

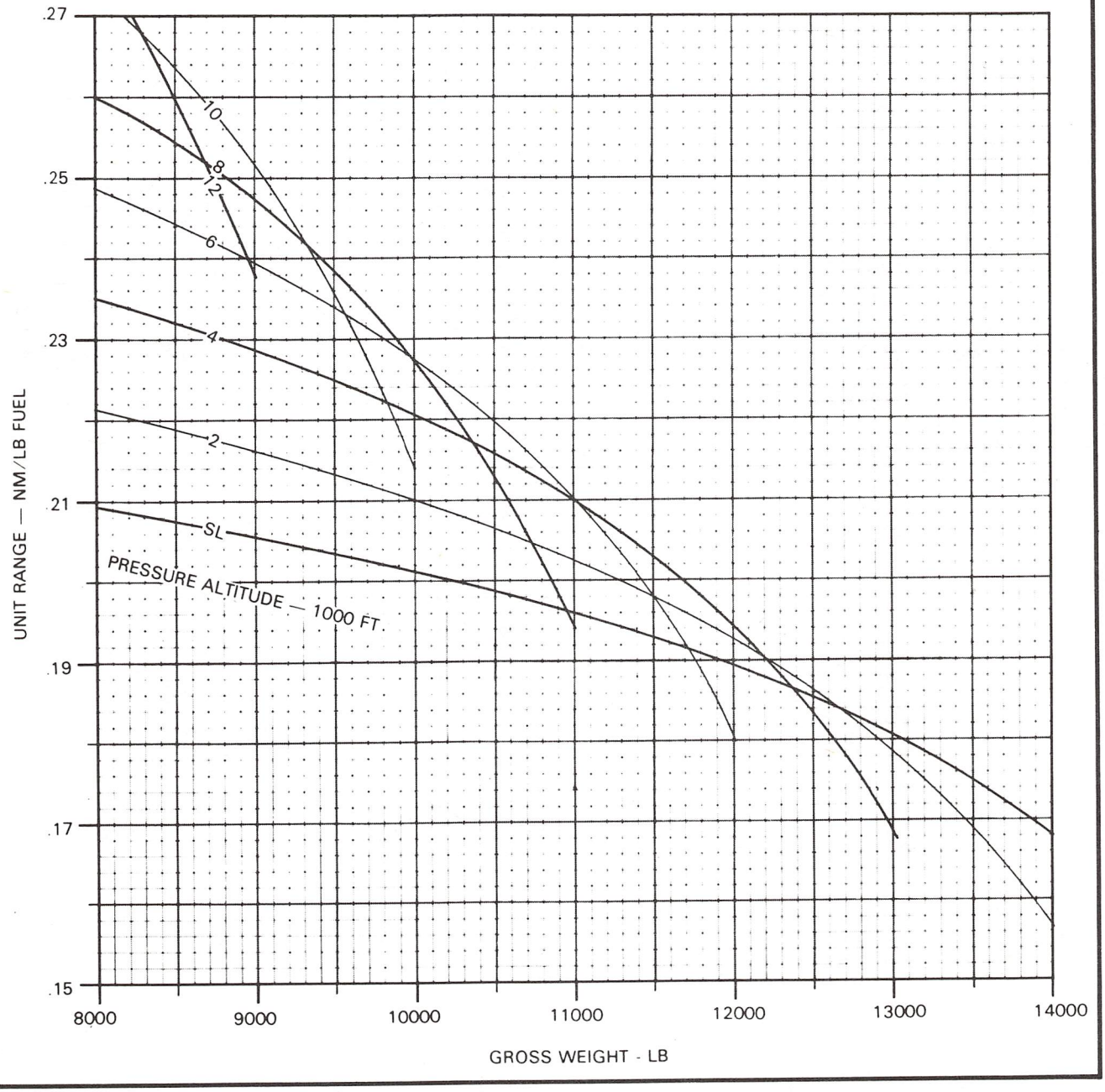


Figure 11-21. Single engine range chart (Sheet 6 of 12)

SINGLE ENGINE RANGE CHART

OAT BETWEEN +10° AND +25°C

INTERMEDIATE RATED POWER
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATION		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	45.1%Q	561 LB/HR
2000	41.7	523
4000	38.4	482
6000	35.1	445
8000	31.8	409
10,000	28.7	372
12,000	25.7	340

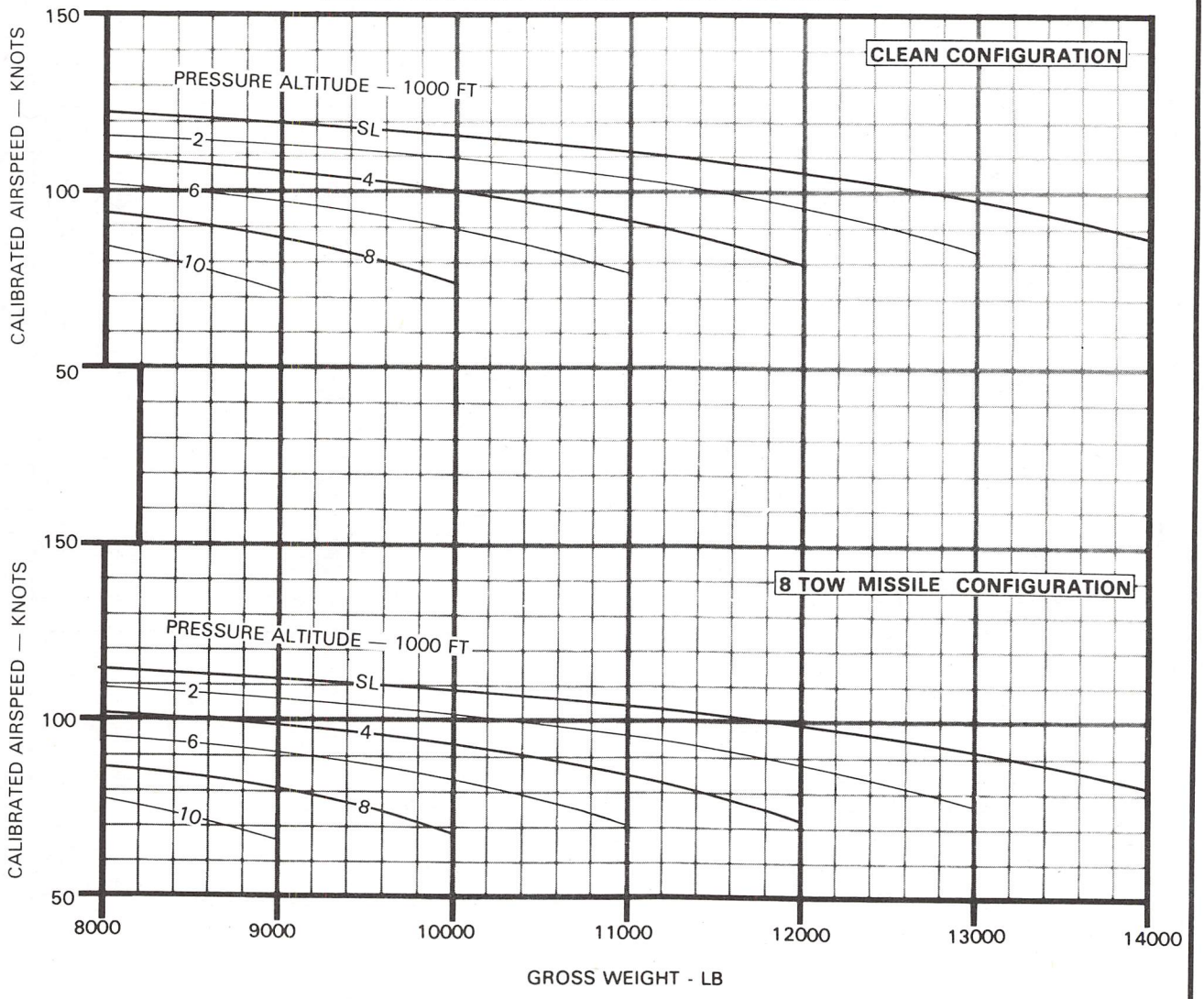


Figure 11-21. Single engine range chart (Sheet 7 of 12)

SINGLE ENGINE RANGE CHART

OAT BETWEEN +10° AND +25°C

INTERMEDIATE RATED POWER
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

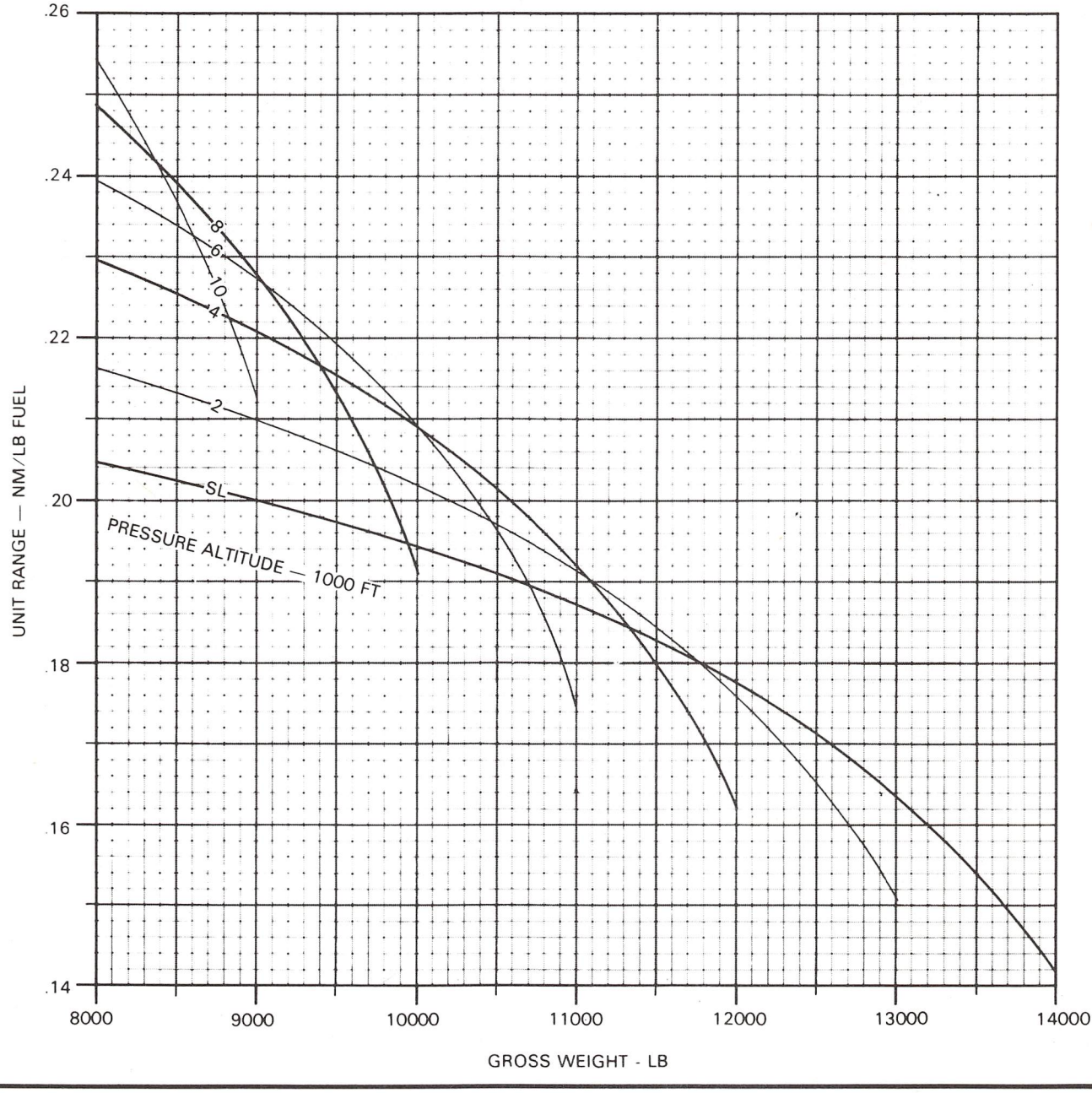


Figure 11-21. Single engine range chart (Sheet 8 of 12)

SINGLE ENGINE RANGE CHART

OAT BETWEEN +10° AND +25°C

INTERMEDIATE RATED POWER
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

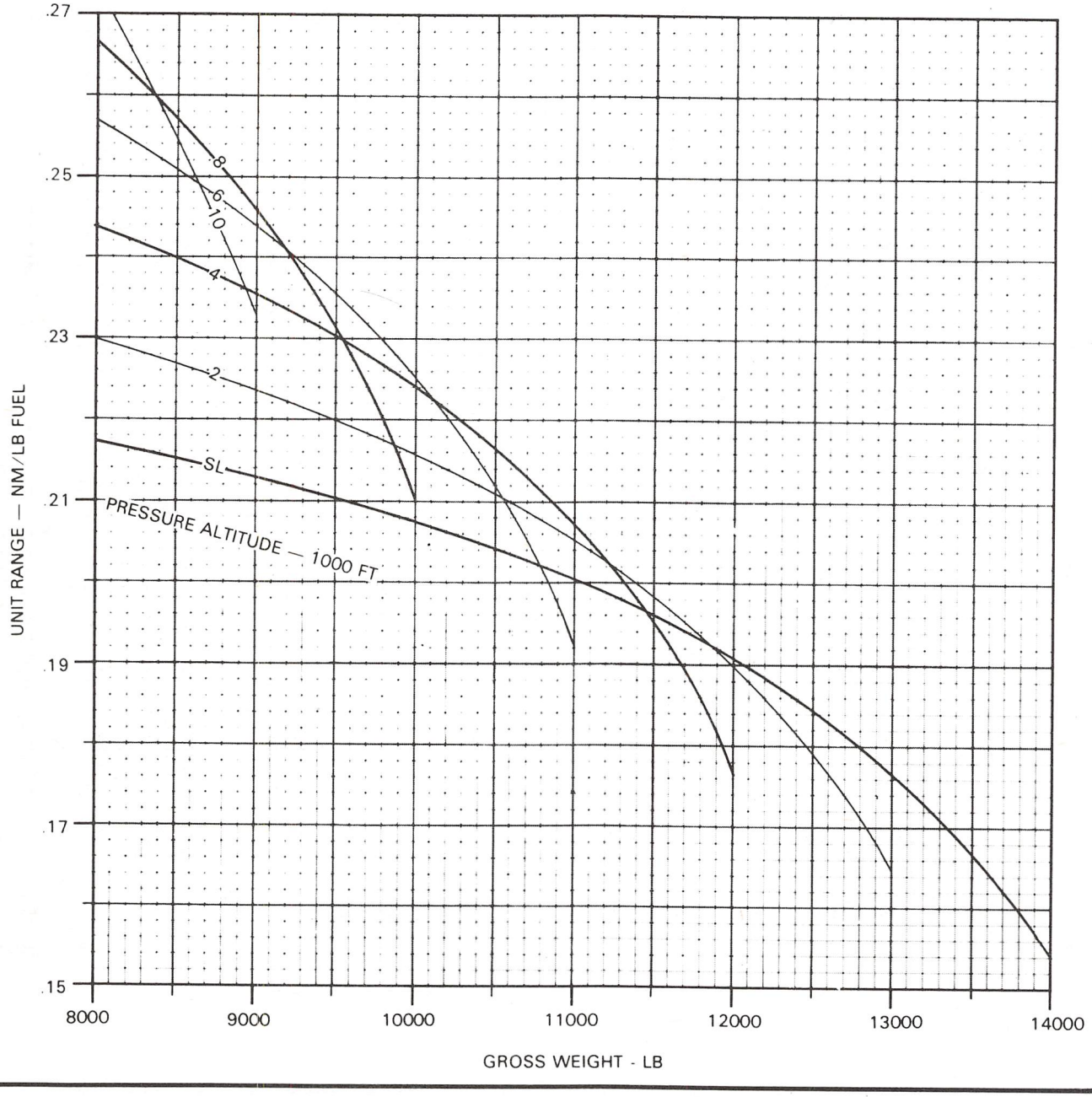


Figure 11-21. Single engine range chart (Sheet 9 of 12)

SINGLE ENGINE RANGE CHART

OAT HOTTER THAN +25°C

INTERMEDIATE RATED POWER
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

ALL CONFIGURATION		
PRESSURE ALT	TORQUE	FUEL FLOW
0 FT	39.1%Q	508 LB/HR
2000	36.3	475
4000	33.4	438
6000	30.5	404
8000	27.7	372
10,000	24.9	339
12,000	- . -	—

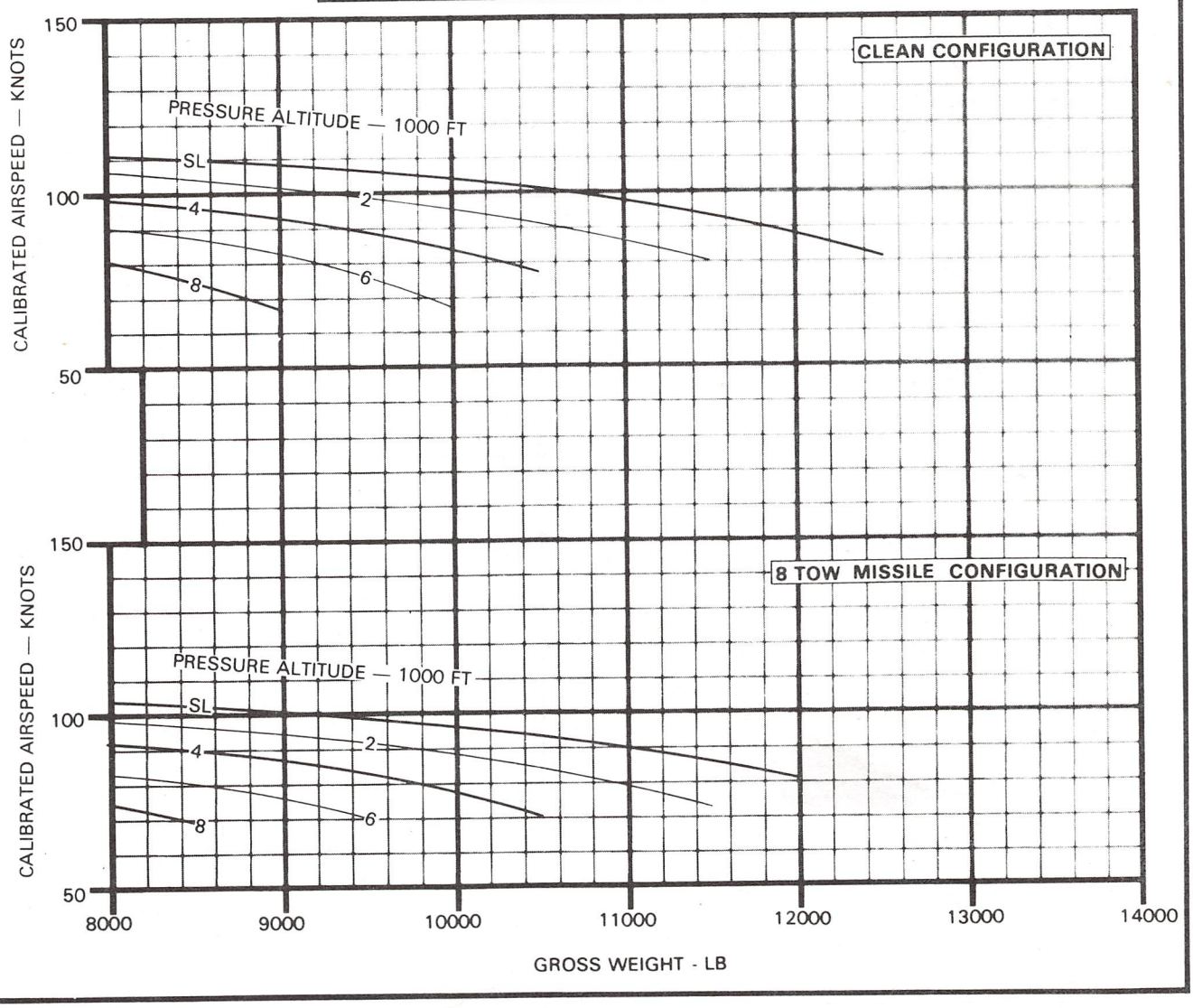


Figure 11-21. Single engine range chart (Sheet 10 of 12)

SINGLE ENGINE RANGE CHART

OAT HOTTER THAN +25°C

INTERMEDIATE RATED POWER
8 TOW MISSILE CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

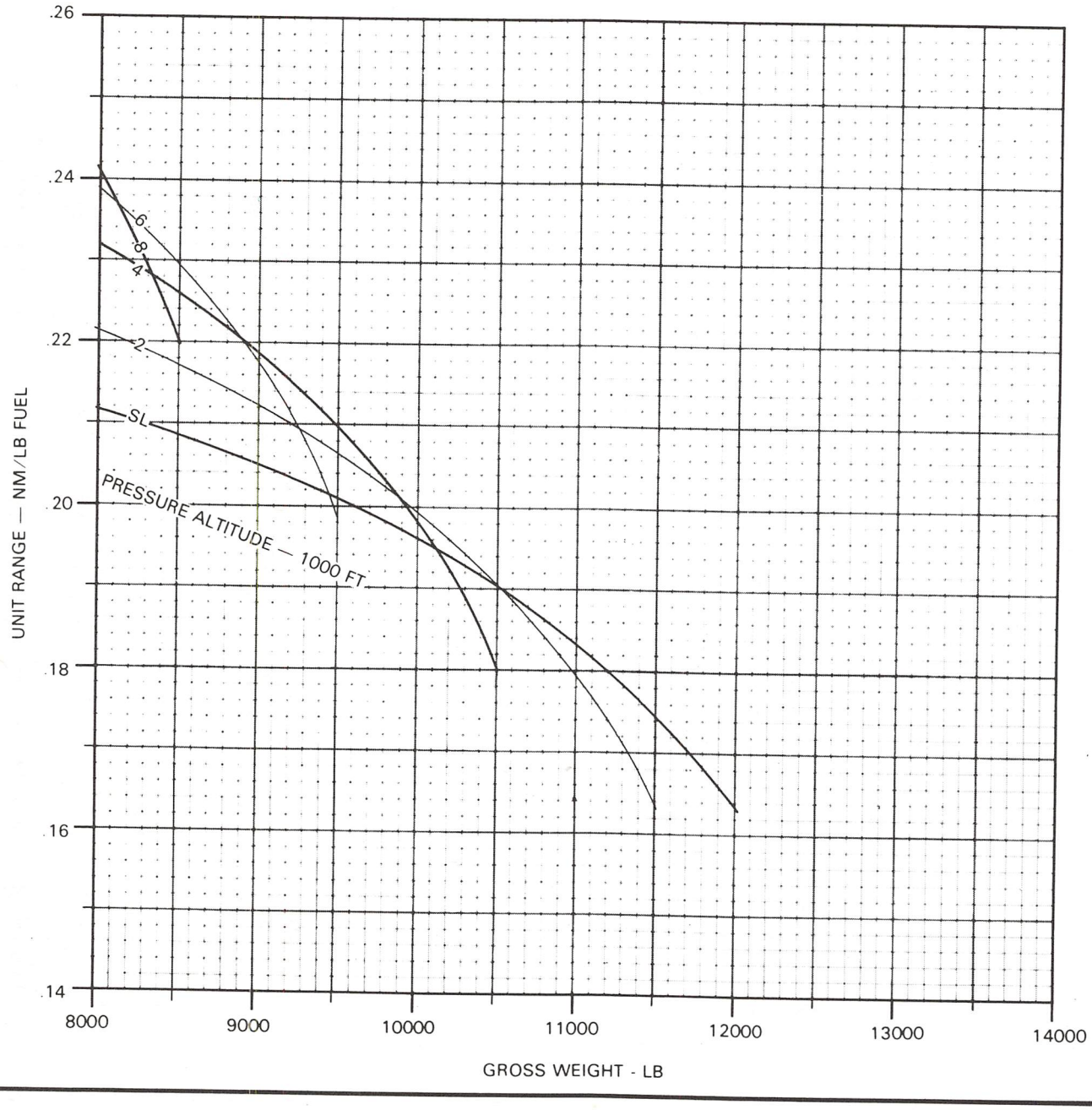


Figure 11-21. Single engine range chart (Sheet 11 of 12)

SINGLE ENGINE RANGE CHART

OAT HOTTER THAN +25°C

INTERMEDIATE POWER
CLEAN CONFIGURATION
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

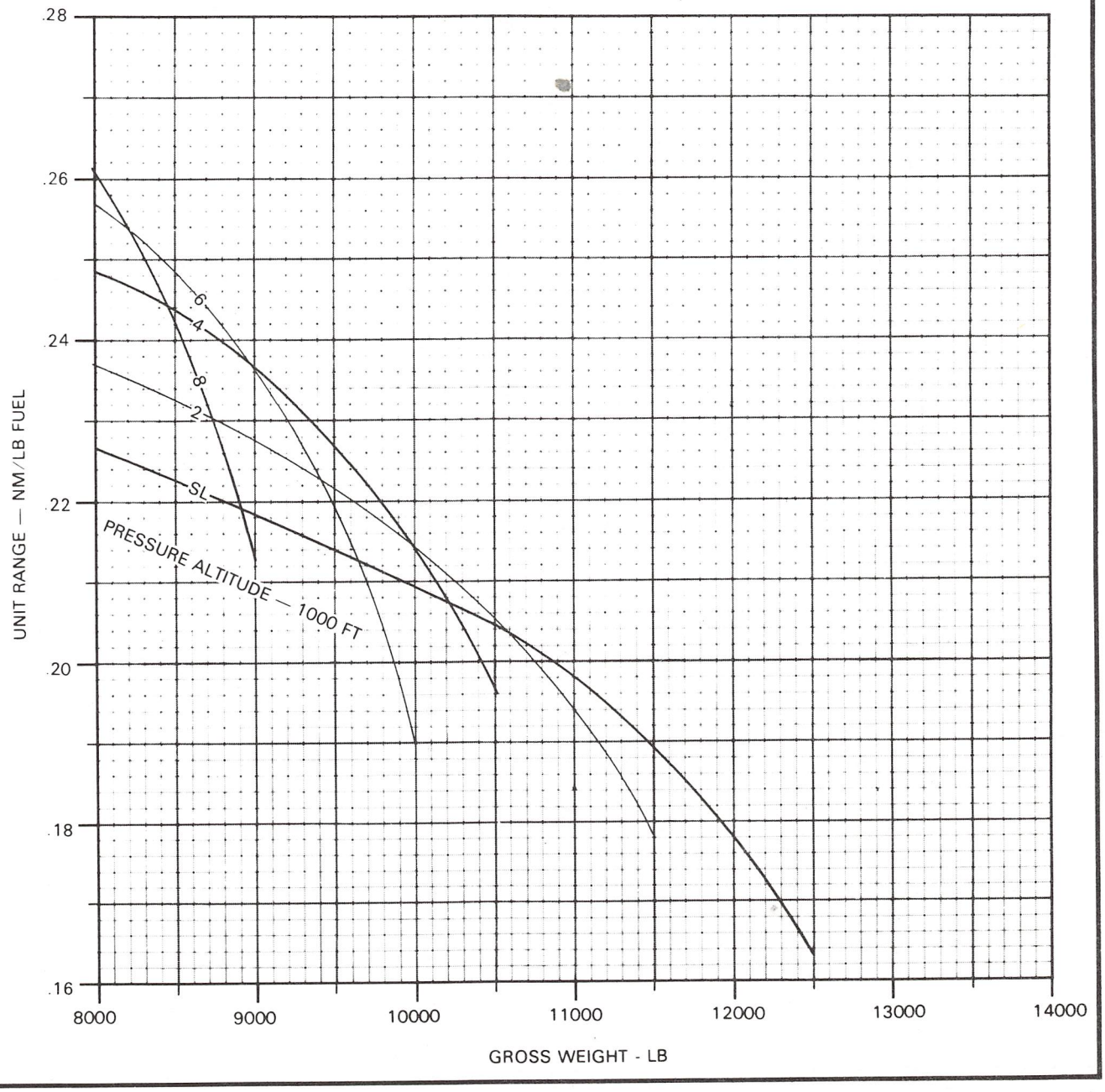


Figure 11-21. Single engine range chart (Sheet 12 of 12)

SINGLE ENGINE MAXIMUM ENDURANCE

OAT COLDER THAN -10°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

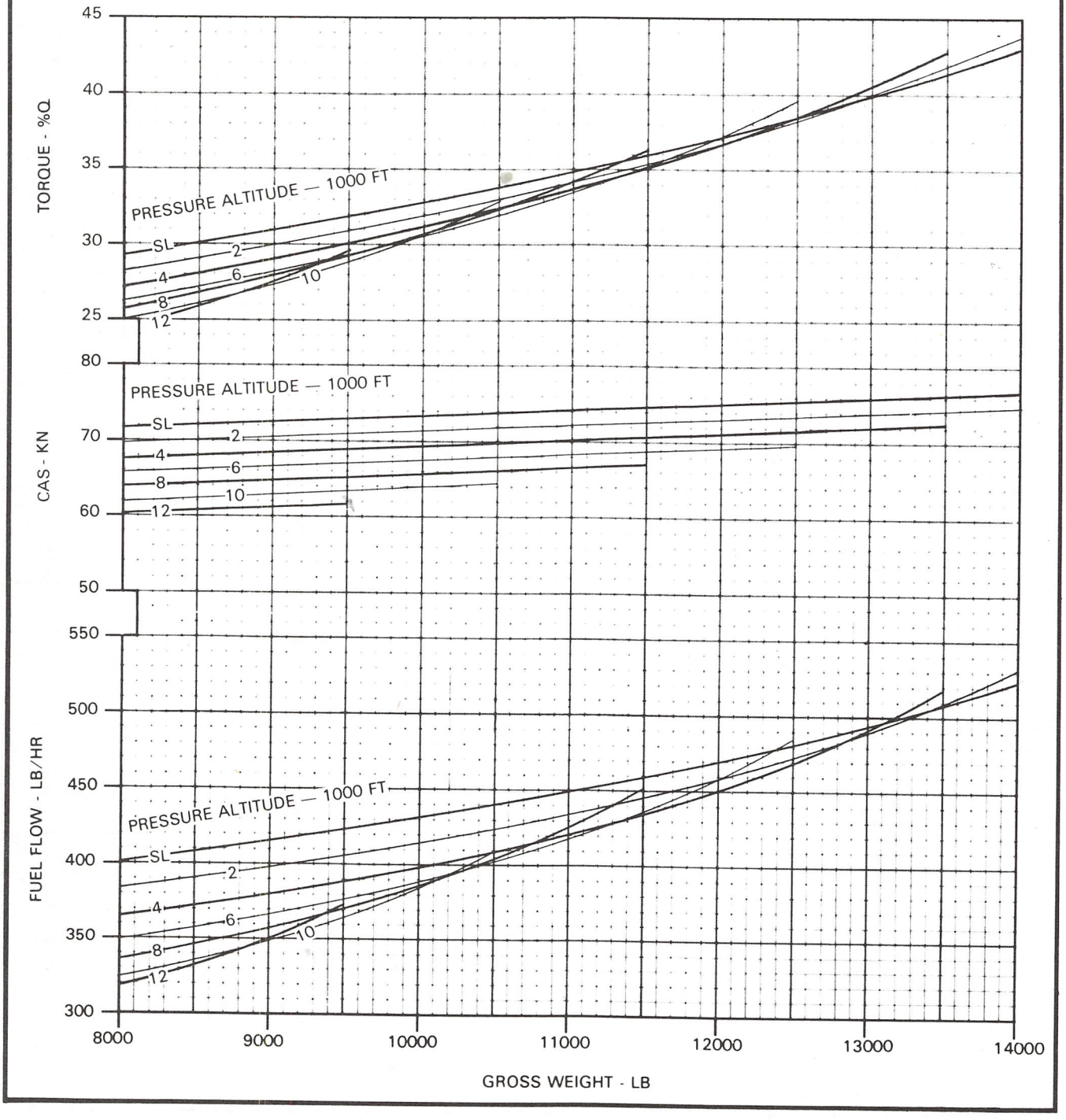


Figure 11-22. Single engine maximum endurance chart (Sheet 1 of 4)

SINGLE ENGINE MAXIMUM ENDURANCE

OAT BETWEEN -10°C AND +10°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

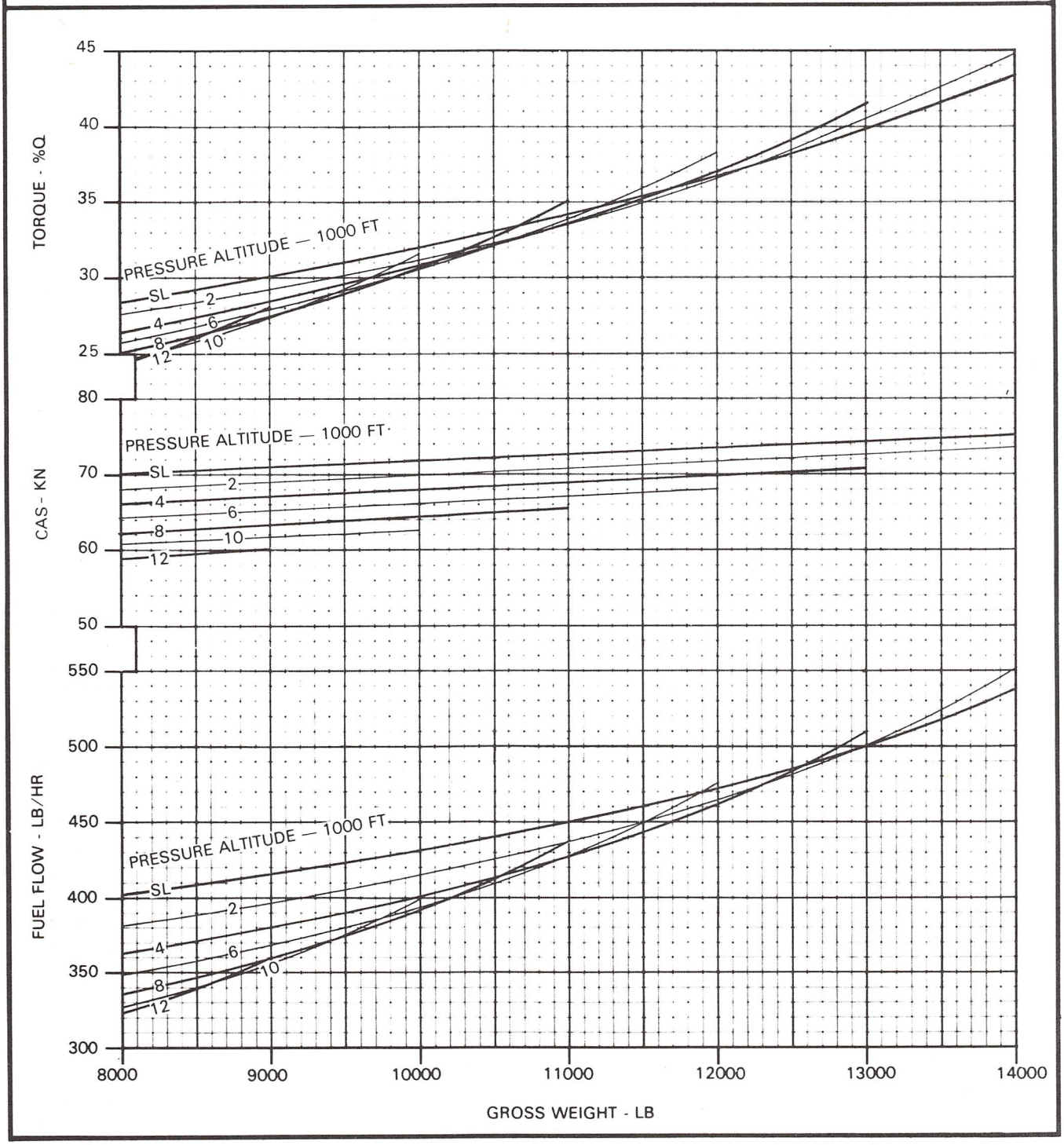


Figure 11-22. Single engine maximum endurance chart (Sheet 2 of 4)

SINGLE ENGINE MAXIMUM ENDURANCE

OAT BETWEEN +10° AND +25°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

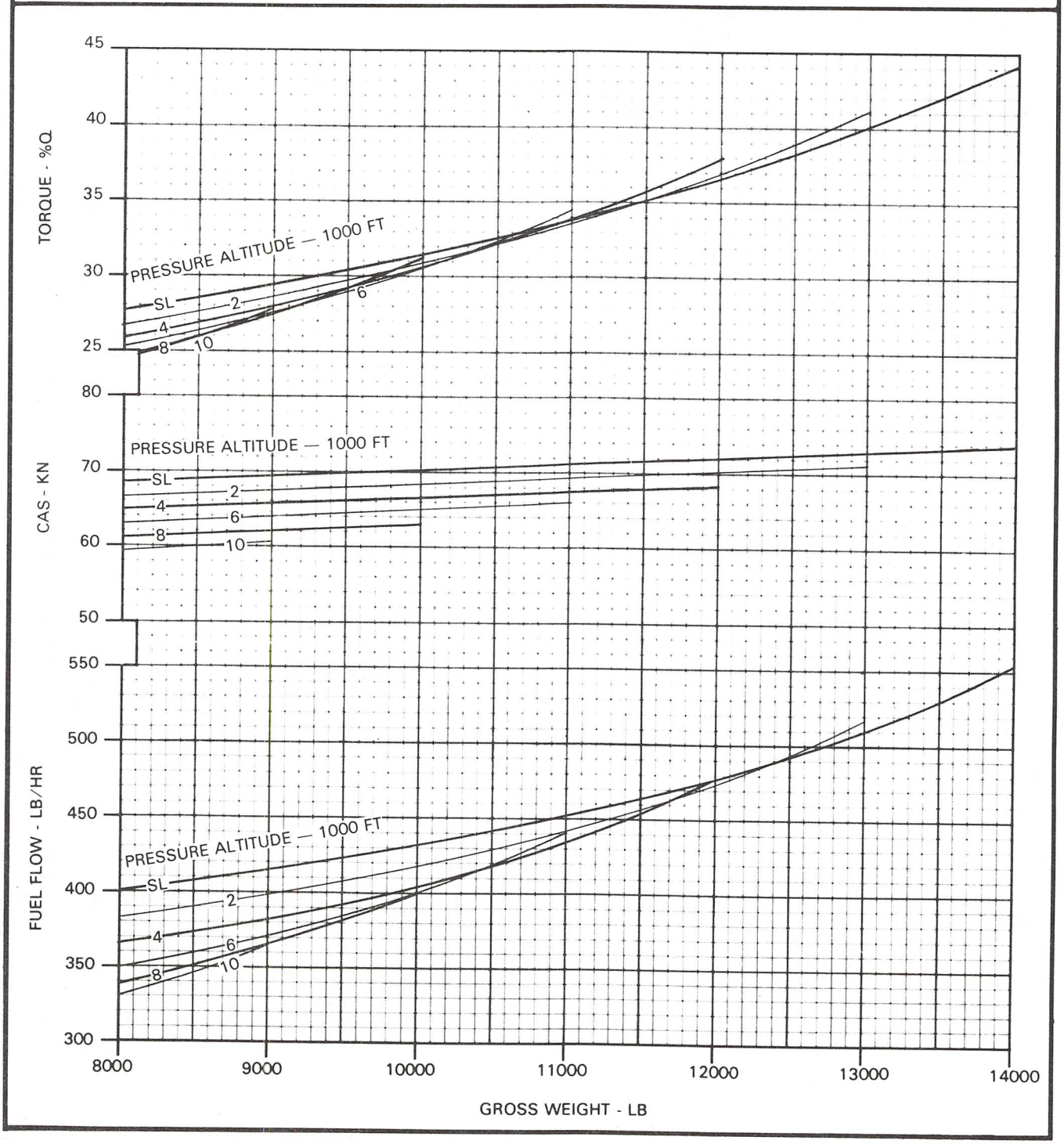


Figure 11-22. Single engine maximum endurance chart (Sheet 3 of 4)

SINGLE ENGINE MAXIMUM ENDURANCE

OAT HOTTER THAN +25°C

ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

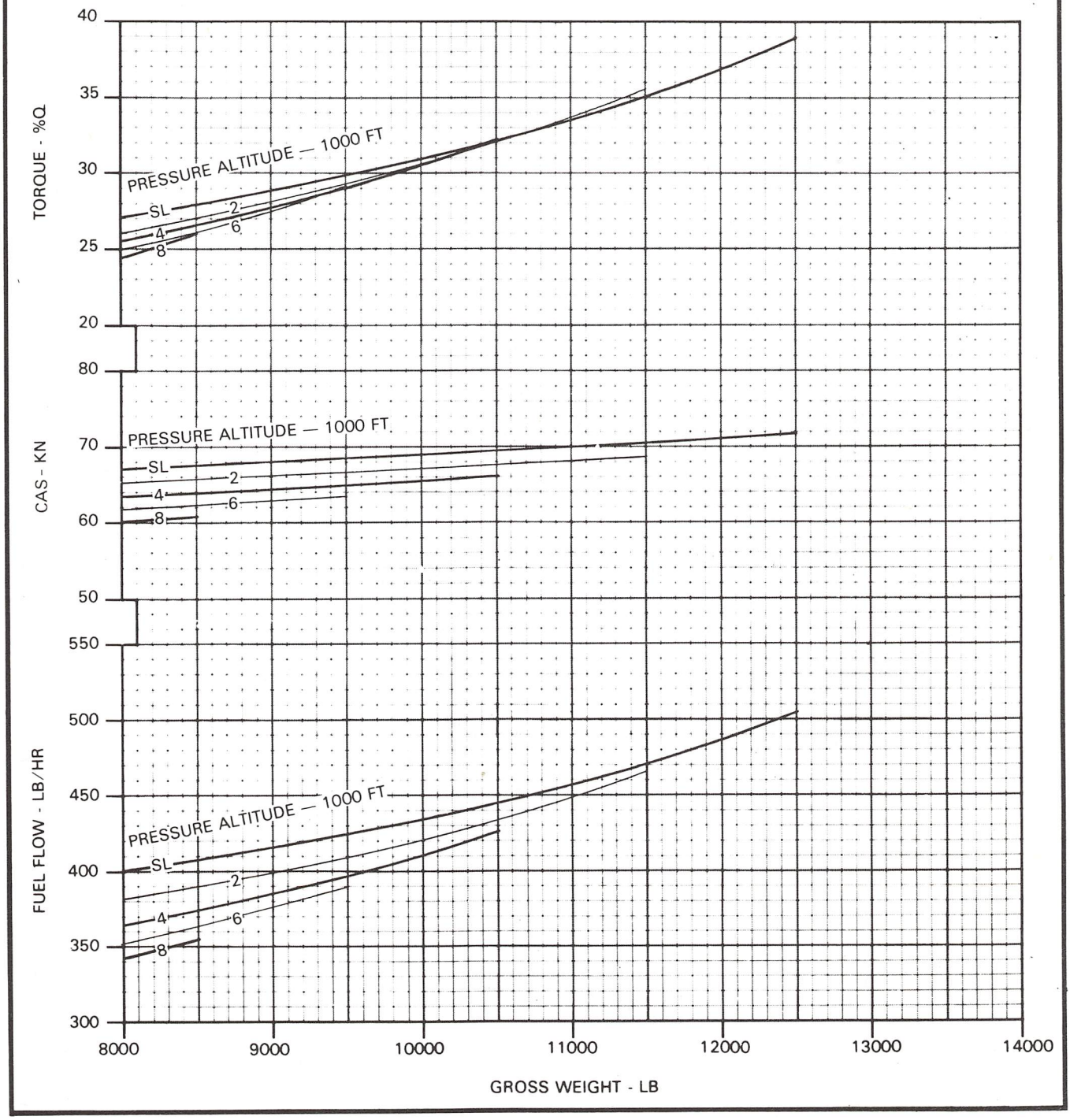


Figure 11-22. Single engine maximum endurance chart (Sheet 4 of 4)

SINGLE ENGINE SERVICE CEILING

INTERMEDIATE RATED POWER
ALL CONFIGURATIONS
100% ENGINE RPM
65 KIAS

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

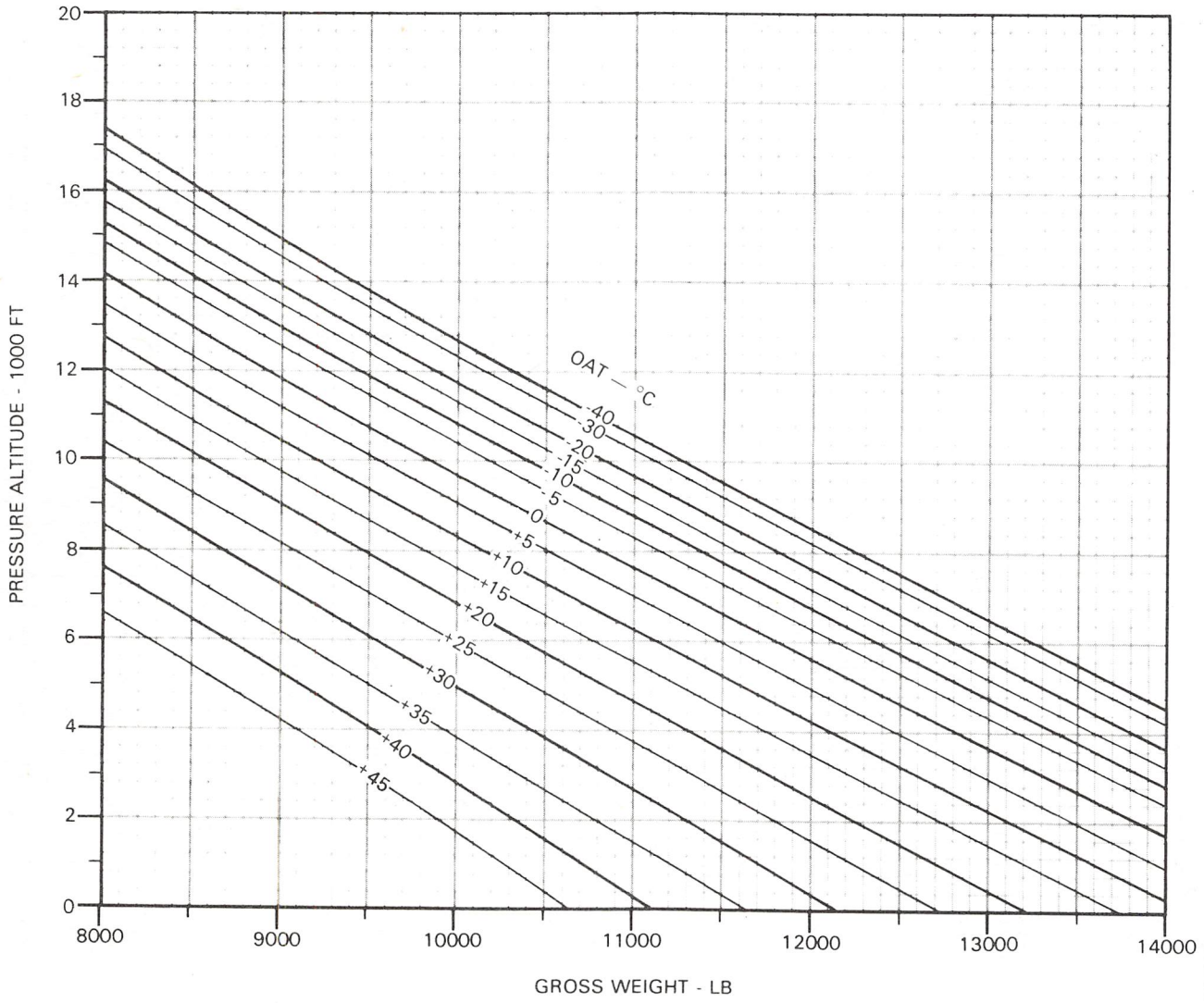


Figure 11-23. Single engine service ceiling chart

ABILITY TO MAINTAIN FLIGHT ON ONE ENGINE

INTERMEDIATE RATED POWER

100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

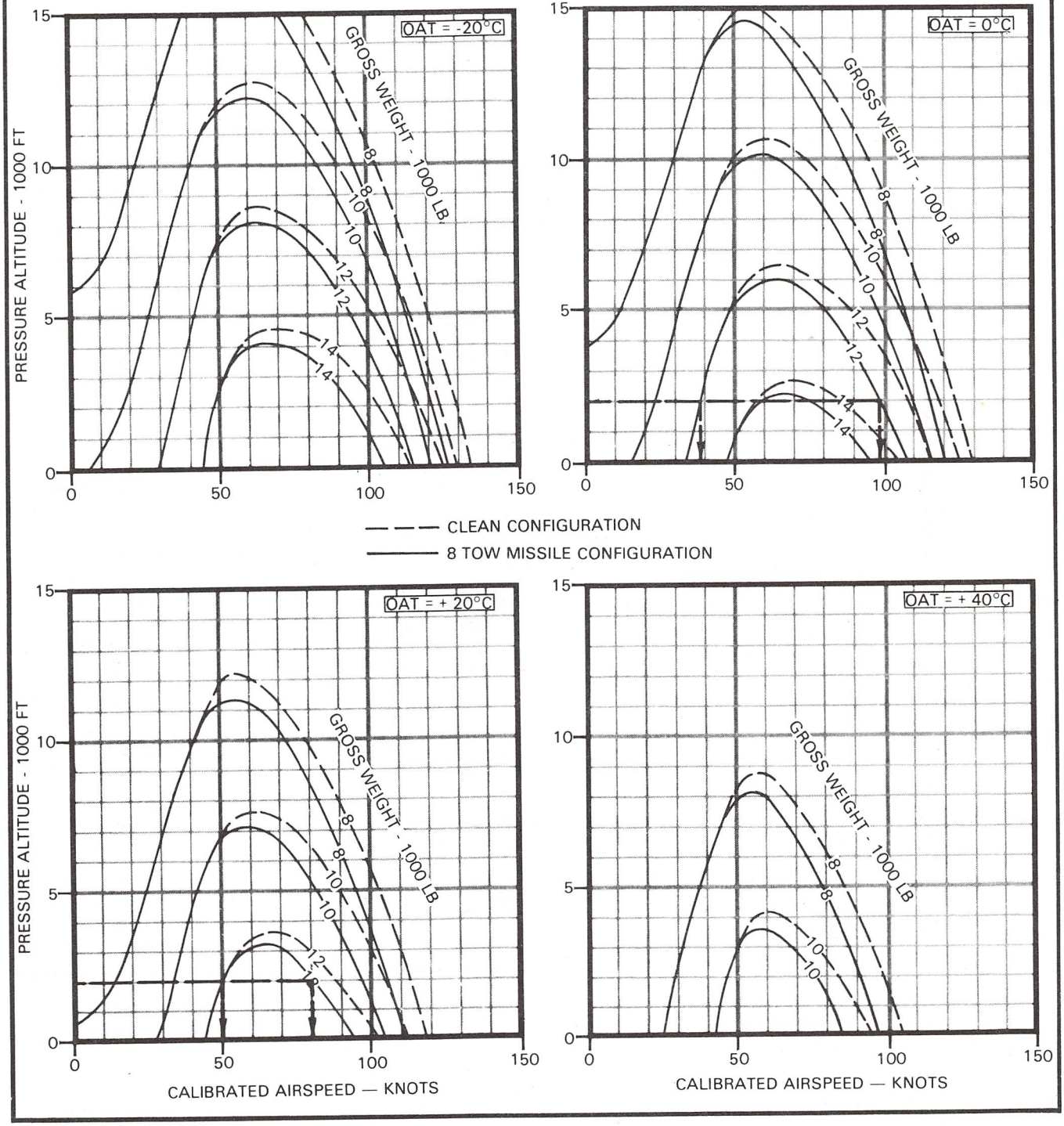


Figure 11-24. Ability to maintain flight on one engine chart

MINIMUM AIRSPEED FOR FLIGHT WITH ONE ENGINE

SEA LEVEL OUT OF GROUND EFFECT
INTERMEDIATE RATED POWER
ALL CONFIGURATIONS
100% ENGINE RPM

MODEL: AH-1T (TOW)
DATE: 1 AUGUST 1978
DATA BASIS: FLIGHT TEST

ENGINE: T400-WV-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

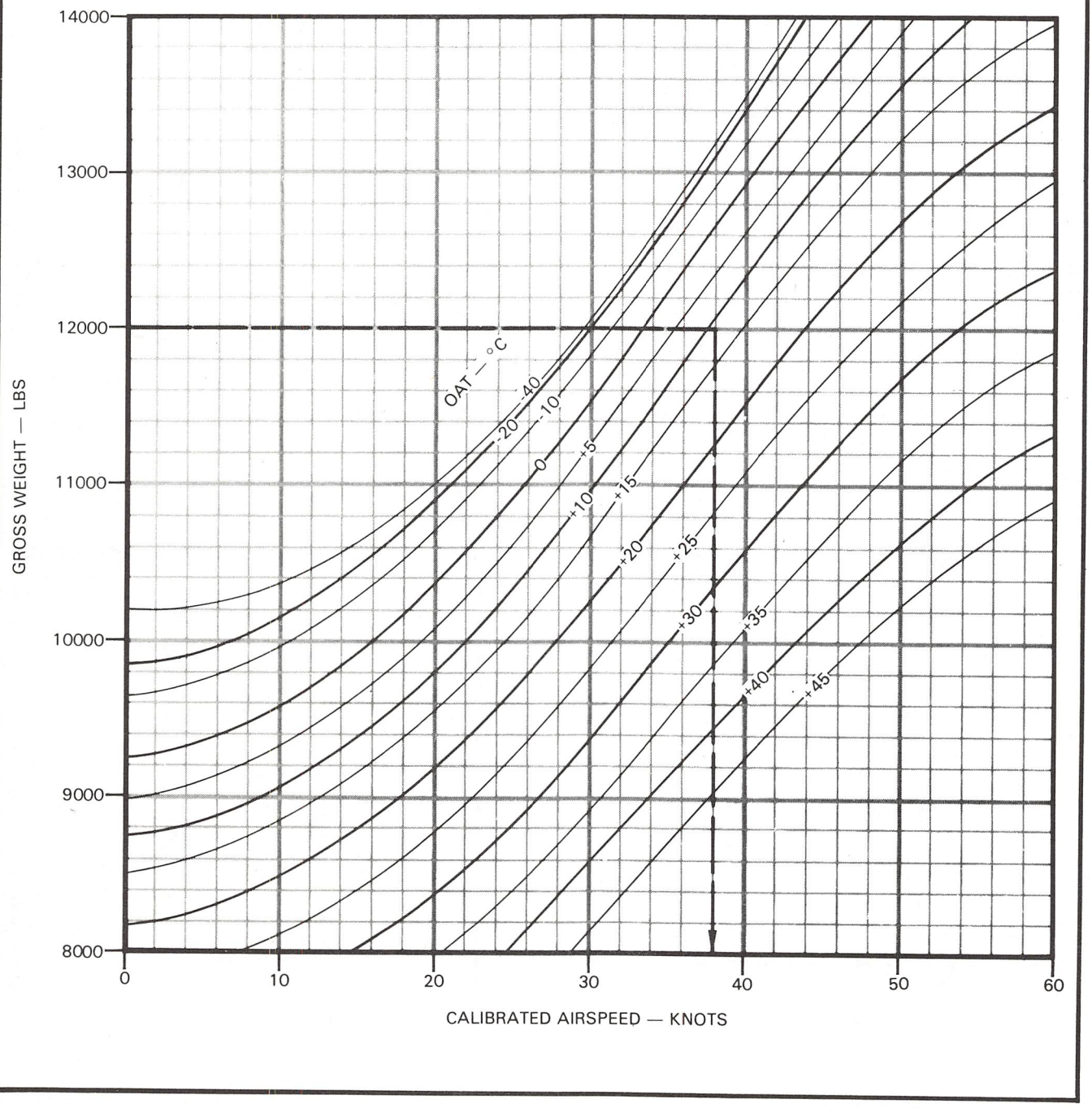


Figure 11-25. Minimum airspeed for flight with one engine chart

PART 7 — SPECIAL CHARTS

RADIUS OF TURN AT CONSTANT AIRSPEED.

The radius of turn at constant airspeed chart (figure 11-26) presents turn radius as a function of true airspeed and bank angle.

EXAMPLE: Determine the bank angle and the turn radius while making a standard 3 degrees per second turn at an airspeed of 97 KTAS.

Solution:

a. Enter figure 11-26 at 97 KTAS. Move up and intersect the standard turn line.

b. Read (or interpolate for) bank angle = 15 degrees.

c. Move left and read a turn radius of 3120 feet.

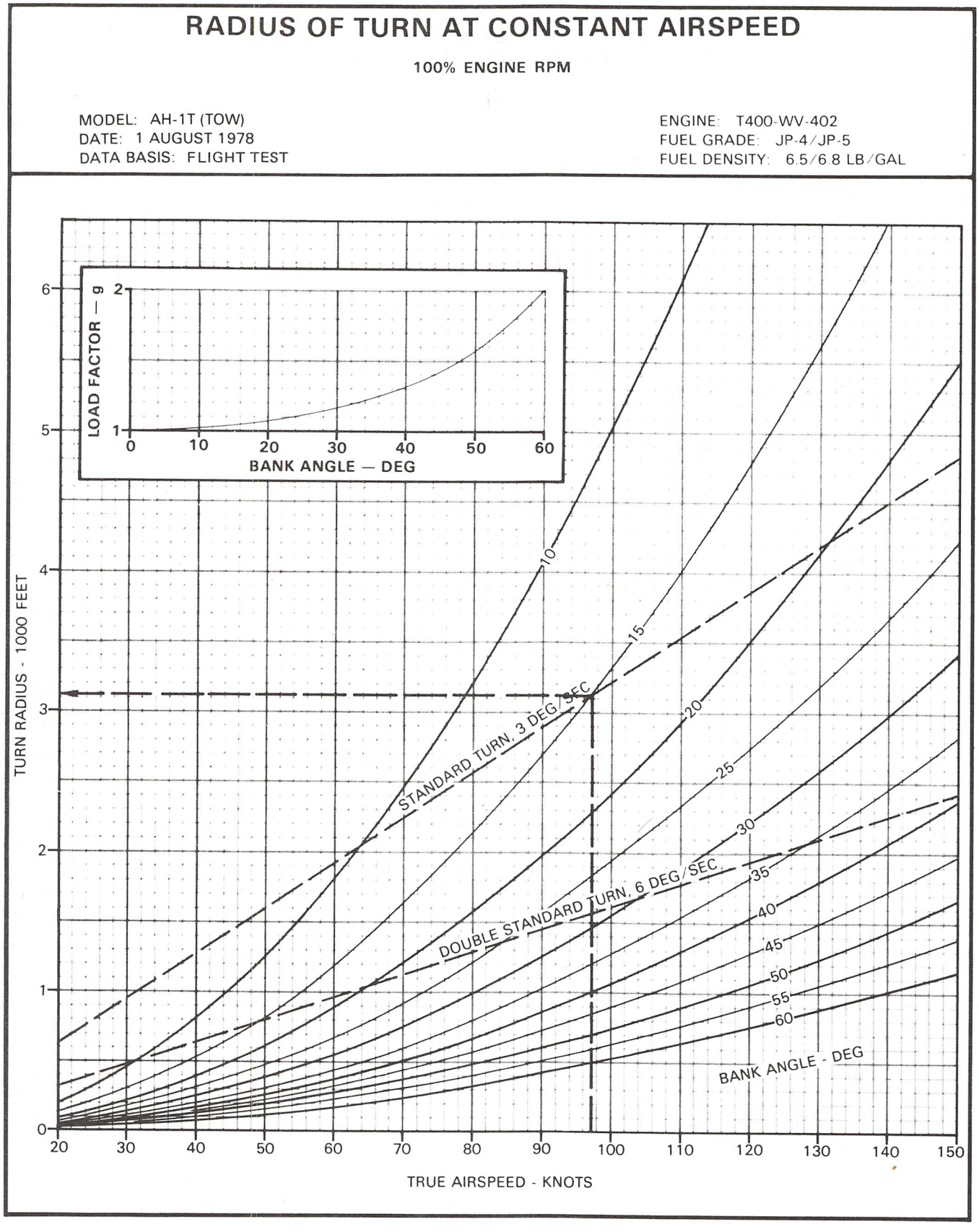


Figure 11-26. Radius of turn at constant airspeed chart

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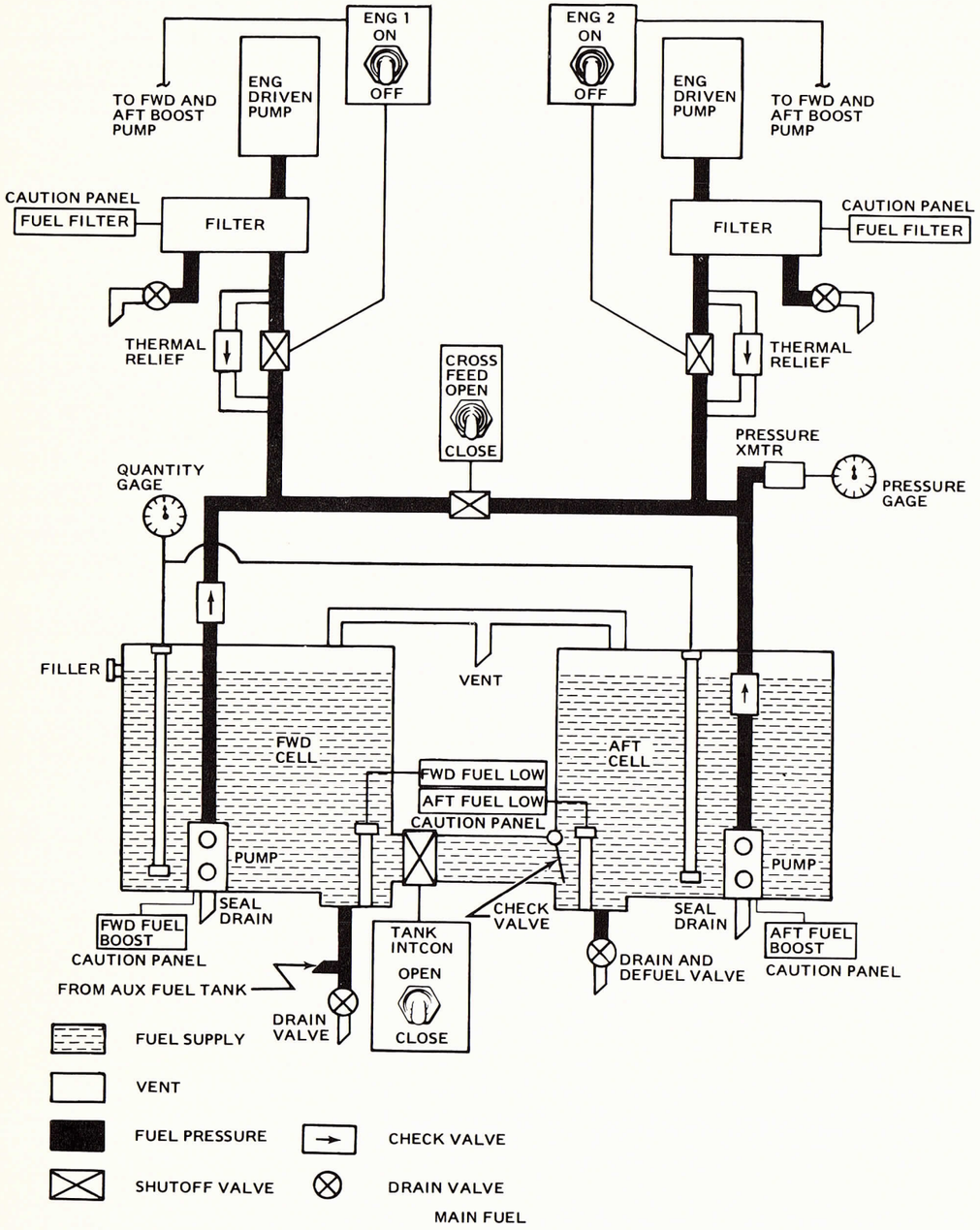
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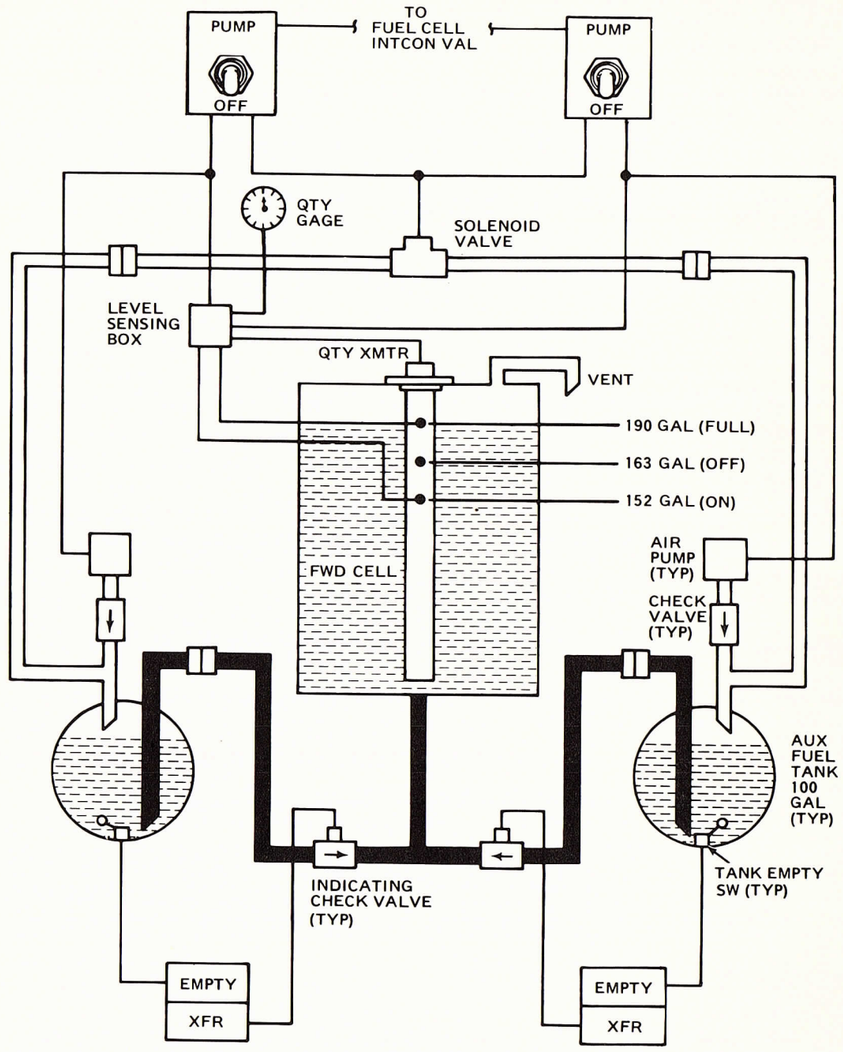
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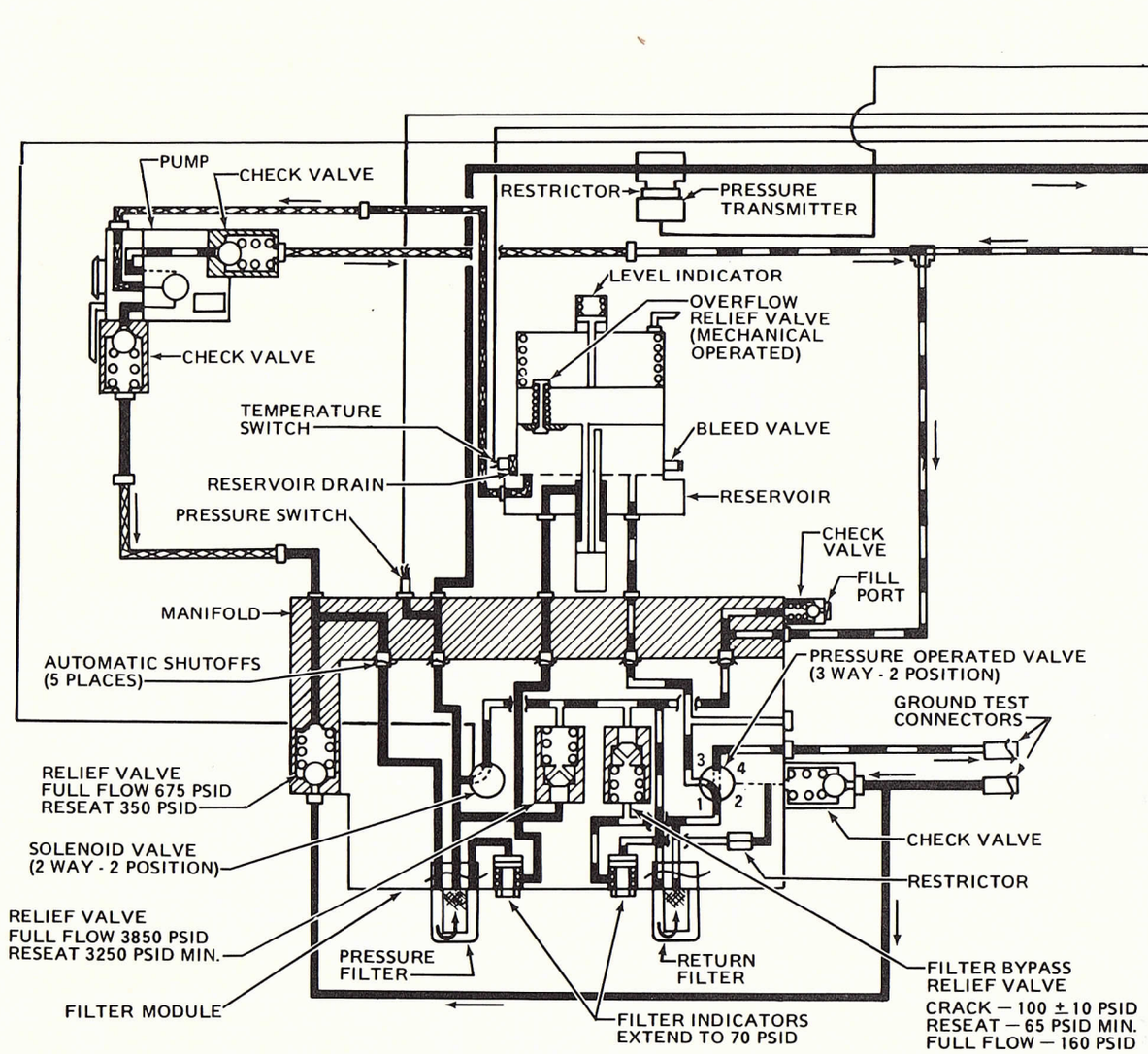


FO-1. Fuel Schematic Diagram





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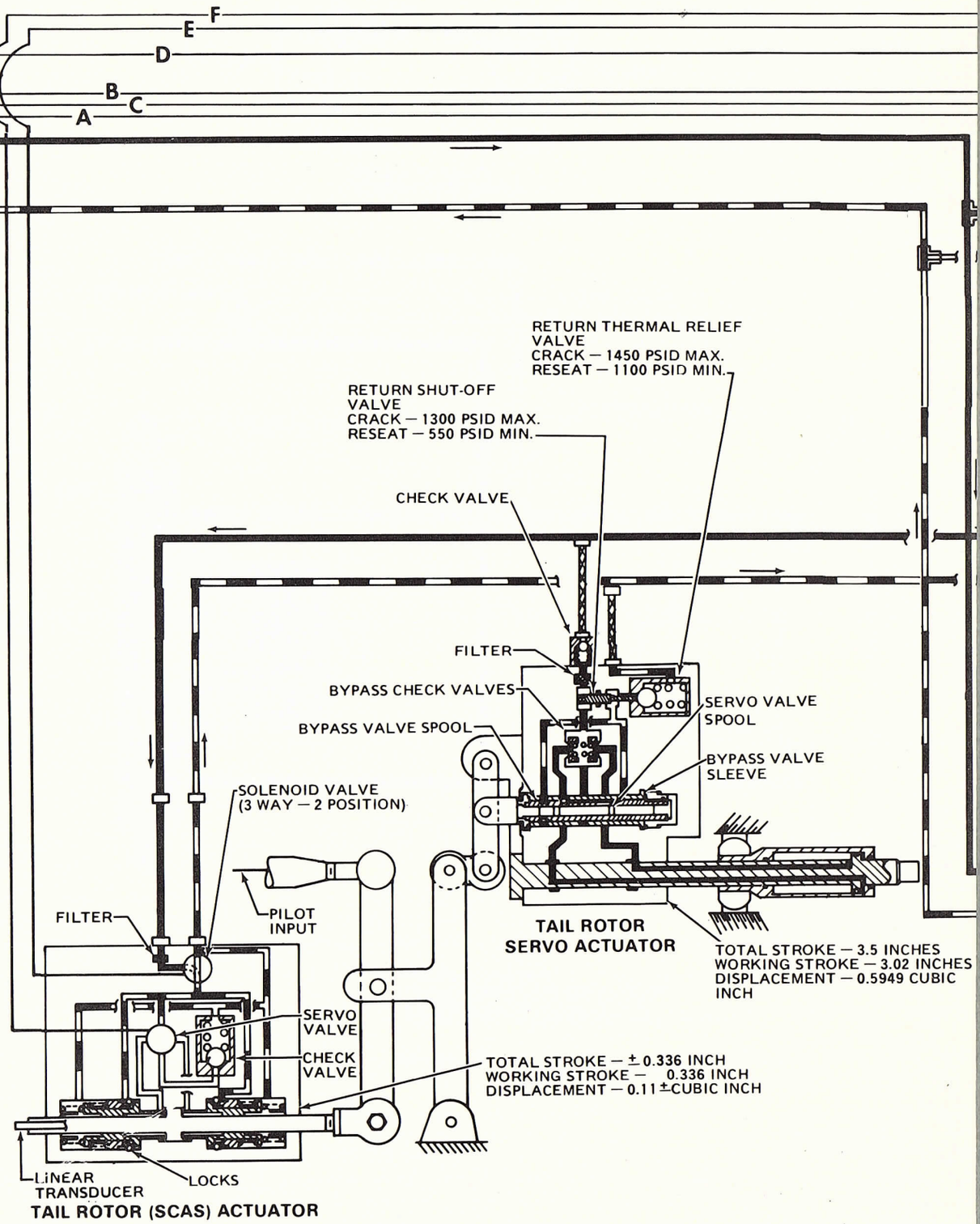


SYSTEM NO. 1

HOSE
PRESSURE
RETURN
SUCTION
DRAIN
FITTING

SYSTEM LEADING PARTICULARS

HYDRAULIC FLUID: MIL-H-83232
SYSTEM TEMPERATURE RANGE: -65° TO 275°F
SYSTEM OPERATING PRESSURE: 3000 PSIG
SYSTEM NO. 1 CAPACITY: 259 CUBIC INCHES
SYSTEM NO. 2 CAPACITY: 330 CUBIC INCHES
MAXIMUM TEMPERATURE RISE: APPROXIMATELY 75.0



TAIL ROTOR (SCAS) ACTUATOR

G H E F I J D K

TOTAL STROKE — 6.156 INCHES
WORKING STROKE — 3.68 INCHES
DISPLACEMENT — 2.8 CUBIC INCH
PER SYSTEM

PILOT INPUT

TOW

PYLON

SYSTEM

SEE DETAIL **A**

TOTAL STROKE — 6.156 INCHES
WORKING STROKE — 5.88 INCHES
DISPLACEMENT — 4.47 CUBIC INCHES
PER SYSTEM

PILOT INPUT

ROTOR BRAKE CONTROL UNIT

STATIC PRESSURE TO ROTOR BRAKE UNITS ON TRANSMISSION

FLOW REGULATOR

TOTAL STROKE — 6.156 INCHES
WORKING STROKE — 4.8 INCHES
DISPLACEMENT — 3.65 CUBIC INCHES
PER SYSTEM

PILOT INPUT

RESTRICTOR

PRESSURE TRANSMITTER

PUMP

CHECK VALVE

LEVEL INDICATOR

TEMPERATURE SWITCH

RESERVOIR

BLEED VALVE

RESERVOIR DRAIN

PRESSURE SWITCH

CHECK VALVE

FILL PORT

MANIFOLD

FILTER MODULE

CHECK VALVE

SYSTEM NO. 2

SOLENOID VALVE (2 WAY - 2 POSITION)

RELIEF VALVE FULL FLOW — 675 PSID RESEAT — 350 PSID

GROUND TEST CONNECTORS

PRESSURE OPERATED VALVE

RELIEF VALVE FULL FLOW — 3850 PSID RESEAT — 3250 PSID MIN.

RETURN FILTER

PRESSURE FILTER

FILTER INDICATORS EXTEND AT 70 PSID

FILTER BYPASS RELIEF VALVE CRACK — 100 ± 10 PSID RESEAT — 65 PSID MIN. FULL FLOW — 160 PSID

SOLENOID VALVE (3 WAY — 2 POSITION)

FILTER

SERVO VALVE

CHECK VALVE

LOCKS

LINEAR TRANSDUCER

FORE AND AFT (SCAS) ACTUATOR

FILTER

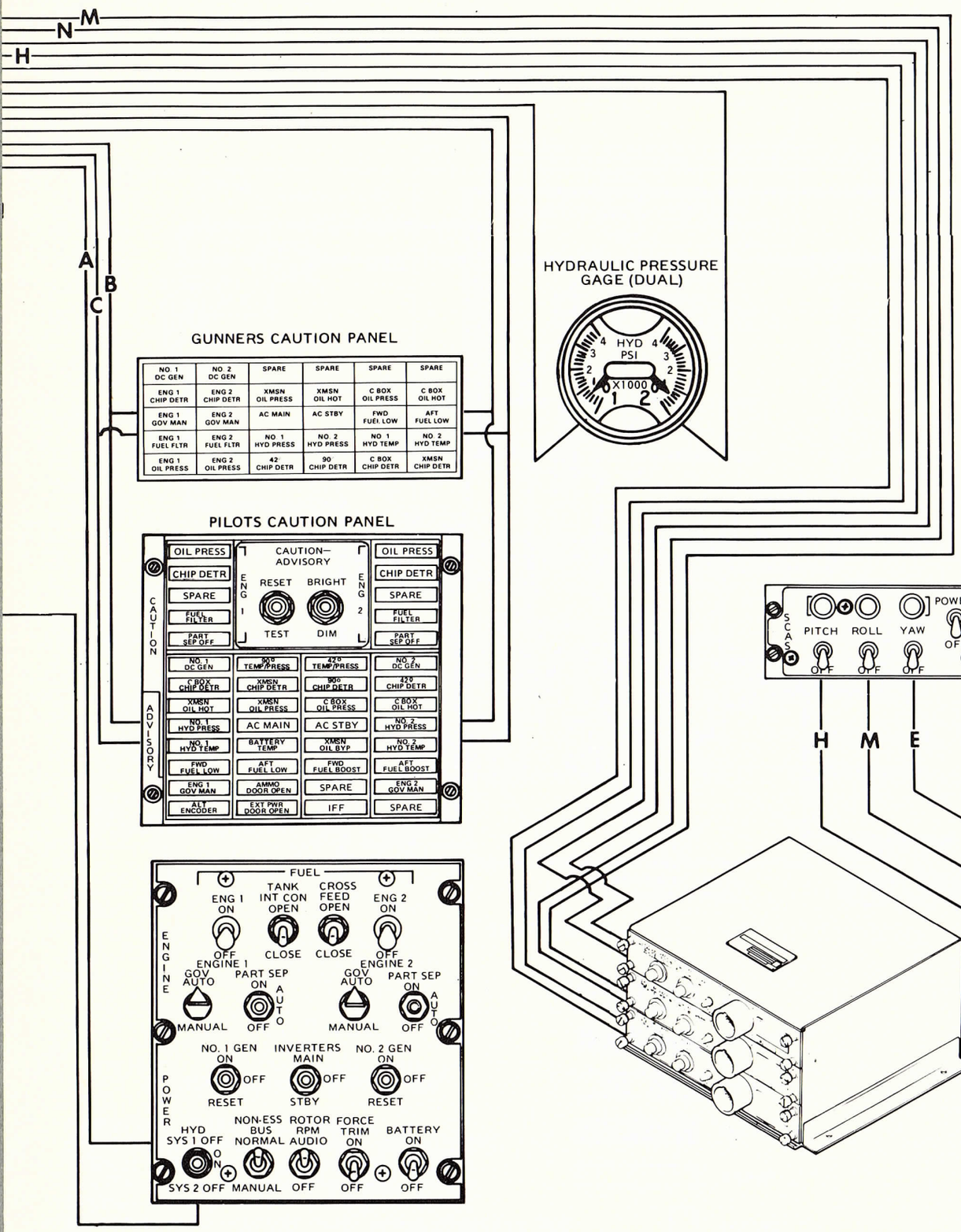
SERVO VALVE

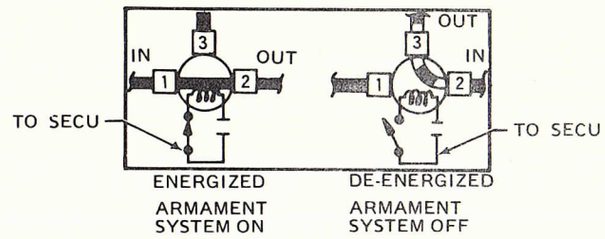
CHECK VALVE

LOCKS

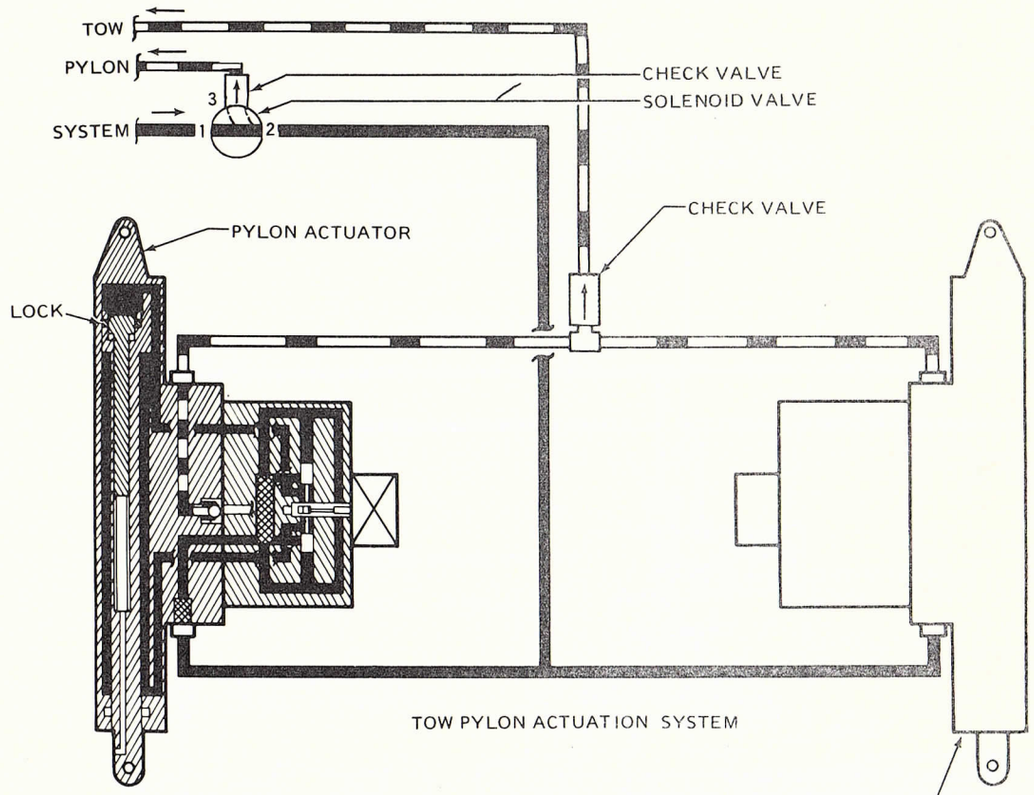
LINEAR TRANSDUCER

LATERAL (SCAS) ACTUATOR



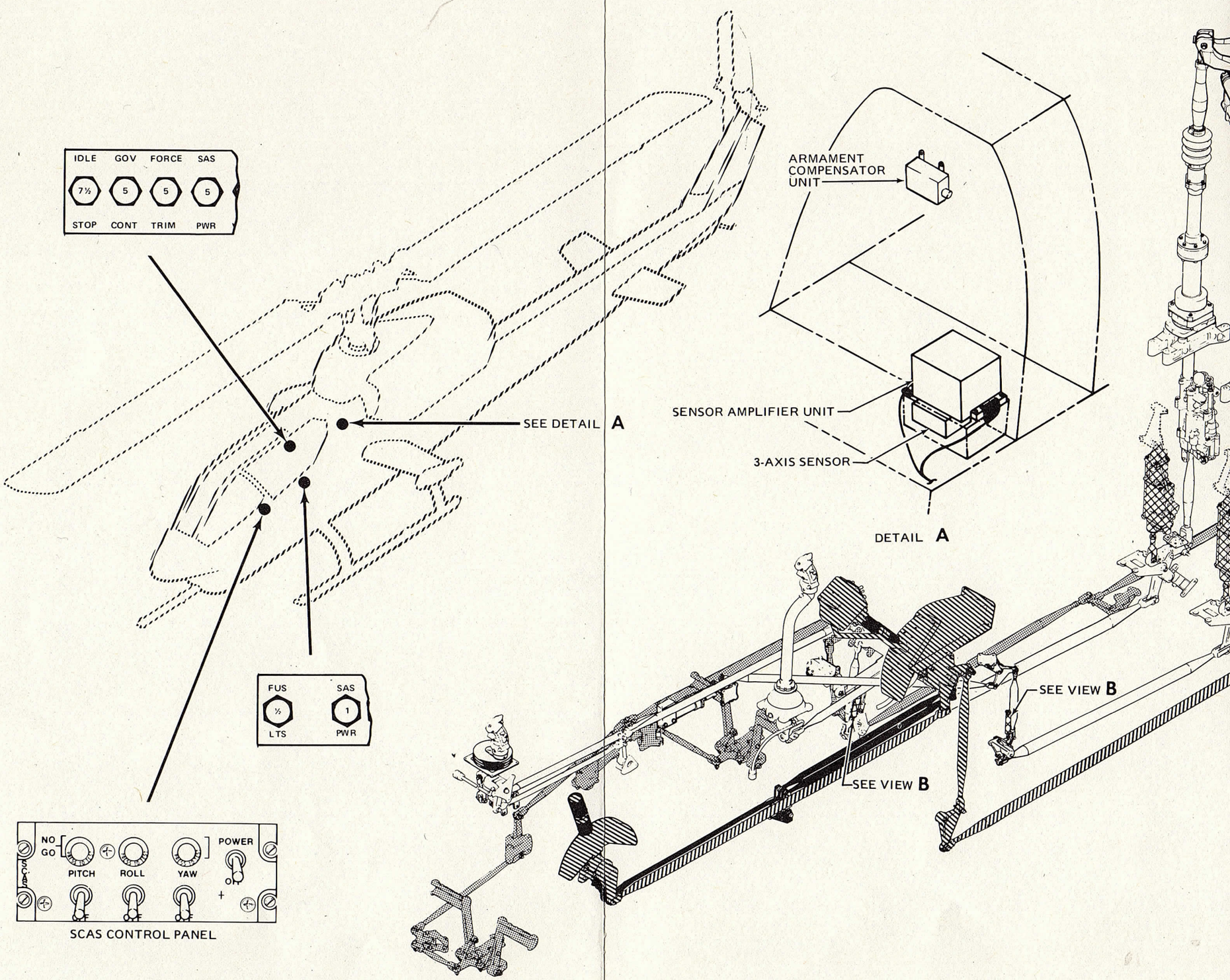


SOLENOID VALVE SCHEMATIC DIAGRAM

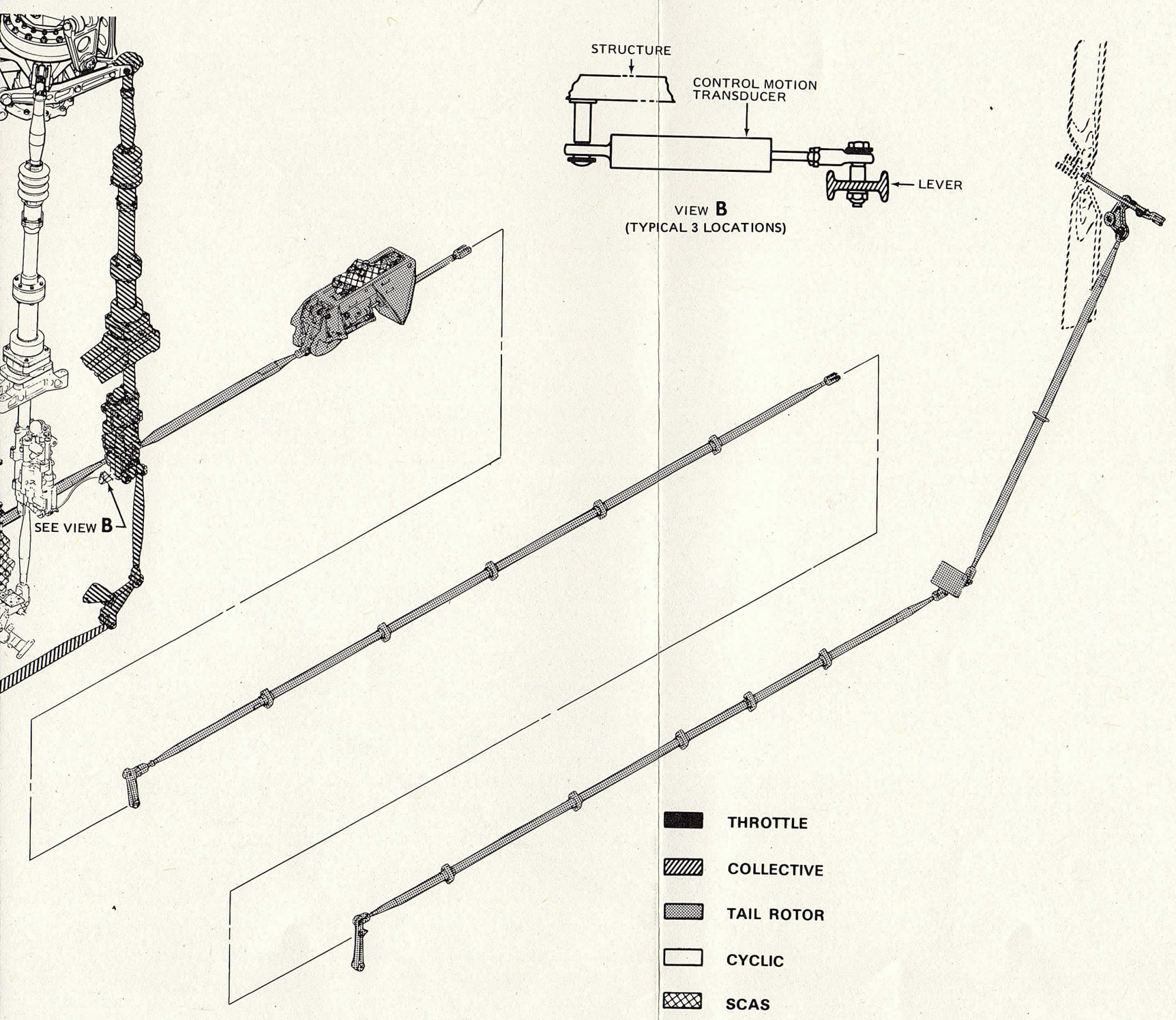


TOW PYLON ACTUATION SYSTEM

210076-78



SCAS CONTROL PANEL



N2/83
210060-3

LEGEND

AC LOAD DISTRIBUTION

DC LOAD DISTRIBUTION

POWER FROM GENERATOR

POWER FROM BATTERY

POWER FROM EXTERNAL POWER RELAY

TURRET DRIVE MOTORS POWER

TURRET GUN MOTOR POWER

TURRET ARMAMENT DC BUS

TURRET ARMAMENT

STARTER SWITCH

28 VDC MAIN BUS

NO. 2 START CONTROL RELAY

STARTER RELAY

STARTER GENERATOR DC NUMBER 2

SHUNT

AMMETER

REVERSE CURRENT RELAY

NO. 2 DC GEN

MAIN TURRET POWER RELAY

NO. 1 DC GEN

SECONDARY TURRET POWER RELAY

AMMETER

SHUNT

REVERSE CURRENT RELAY

STARTER GENERATOR DC NUMBER 1

STARTER RELAY

NO. 1 START CONTROL RELAY

EXTERNAL POWER RECEPTACLE

EXTERNAL POWER VOLTAGE PROTECTION RELAY

EXTERNAL POWER RELAY

MAIN 28V DC BUS

28V DC ESS BUS

INVERTERS SWITCH

MAIN

STBY

STANDBY INVERTER CONTROL RELAY

DC VOLTMETER

NON ESS BUS SWITCH

NORMAL

MANUAL

NON ESS BUS RELAY

28V DC NON ESS BUS

PILOT DOOR

GUNNER DOOR

BATTERY RELAY

BATTERY

GUNNER ELECTRIC POWER SWITCH

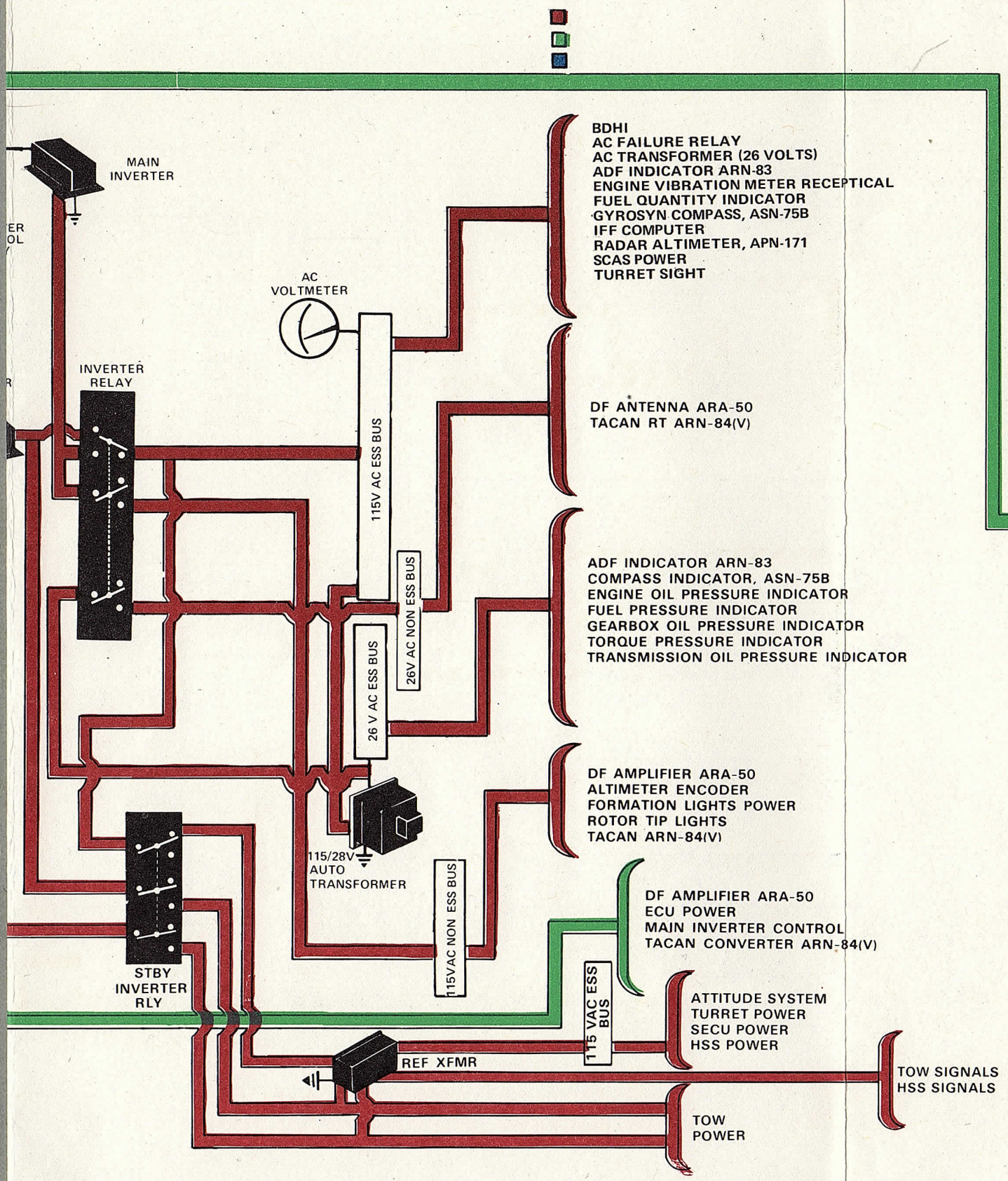
ELEC PWR

ON

EMER OFF

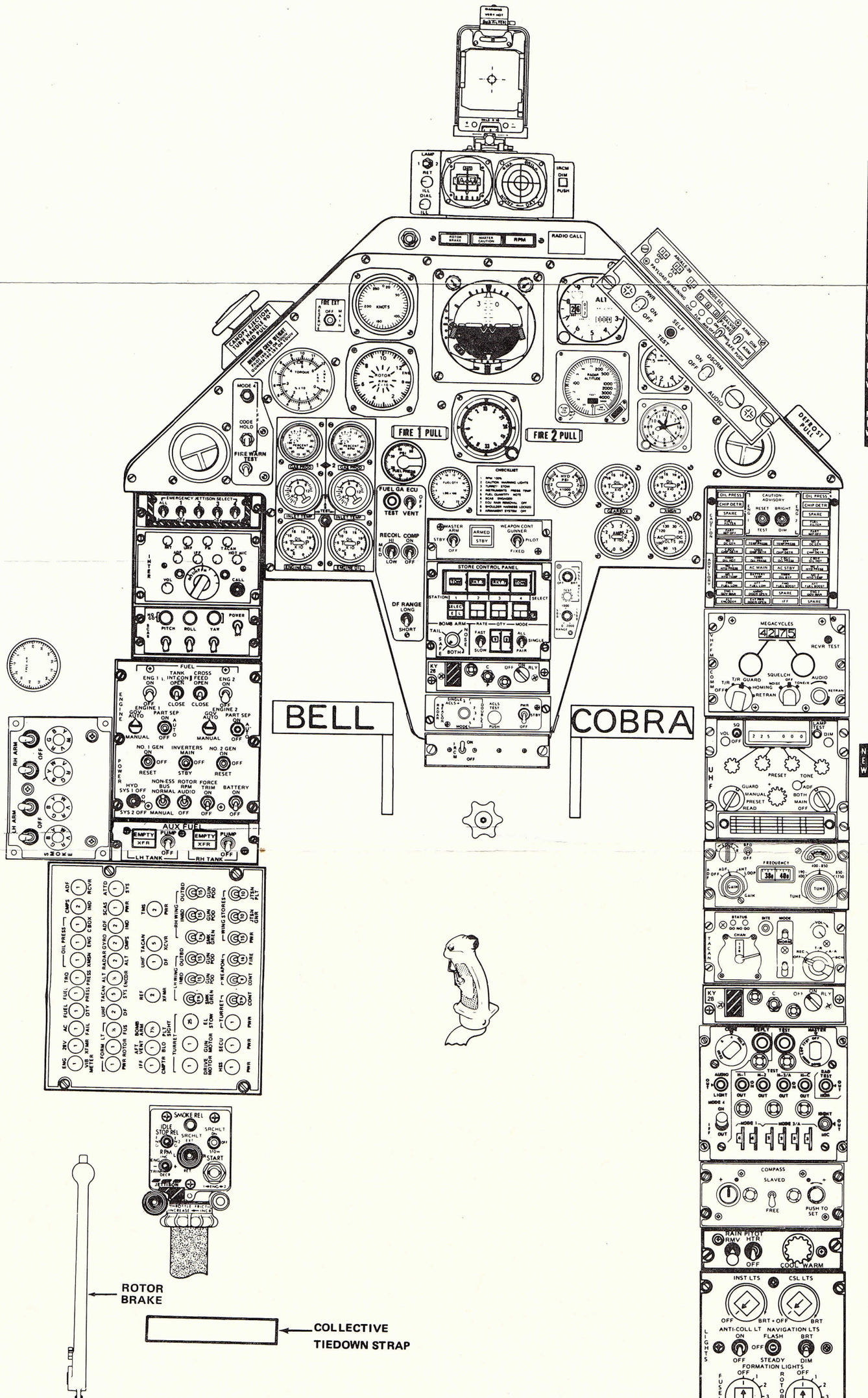
OFF

PILOT BATTERY SWITCH

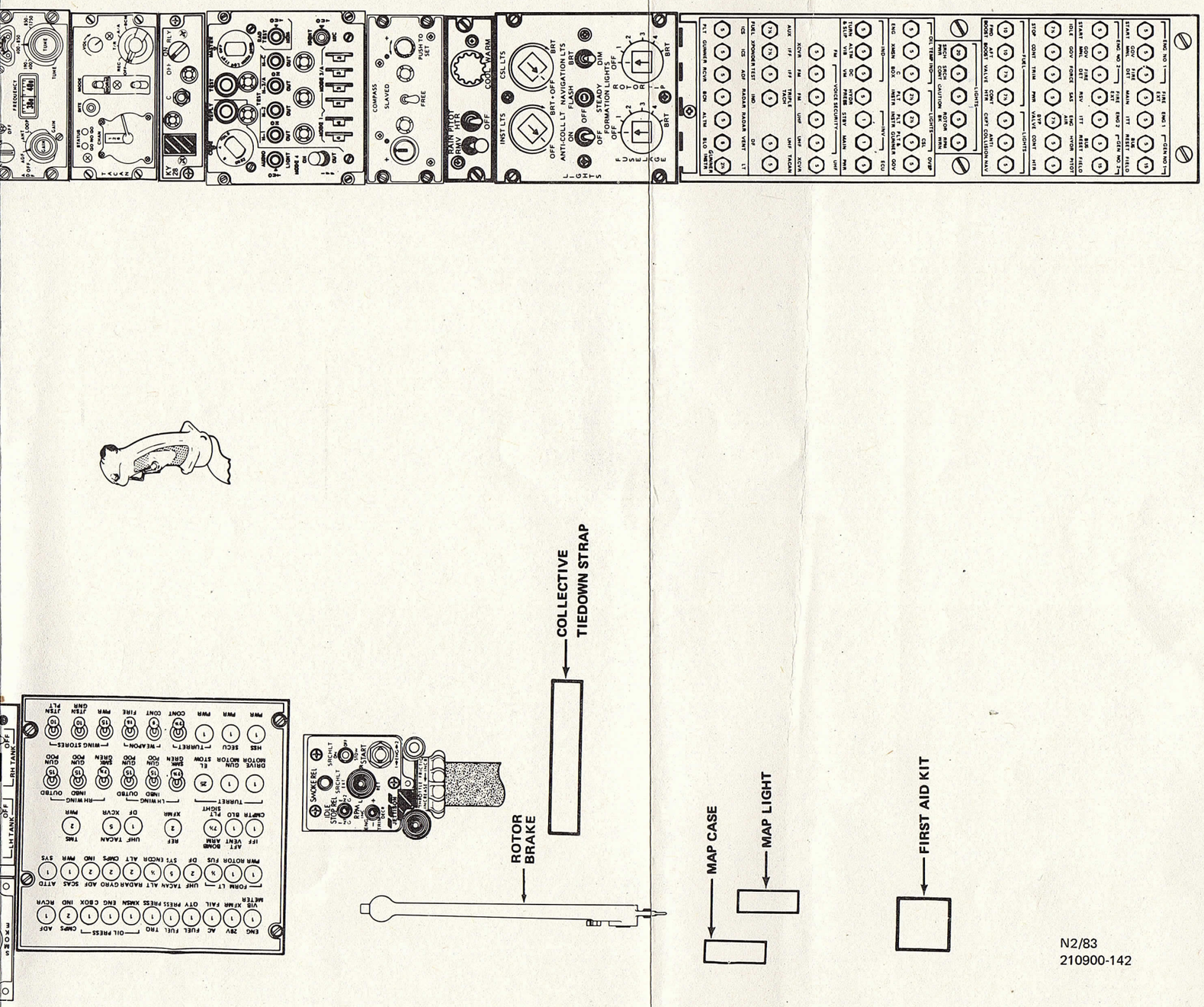


ADF RECEIVER, ARN-83
ALTIMETER VIBRATOR
ANTICOLLISION LIGHT
AUXILIARY FUEL SYSTEM
CAUTION LIGHTS
COCKPIT LIGHTS (MAP)
COUNTERMEASURES DISPENSING SYSTEM, ALE-39 NEW
COUNTERMEASURES SYSTEM, ALQ-144
DC DUAL VOLTMETER
ENGINE AIR BYPASS VALVE (PARTICLE SEPARATOR)
ENGINE NO. 1 AND NO. 2 OIL PRESSURE
ENGINE NO. 1 AND NO. 2 ITT
ENGINE START NO. 1 AND NO. 2
ENGINE XMSN, AND GEARBOX OIL TEMPERATURE INDICATOR
FIRE DETECTION ENGINE NO. 1 AND NO. 2
FIRE EXTINGUISHER RESERVE AND MAIN
FM RADIO ARC-114A
FM KY-28
FUEL BOOST FORWARD AND AFT
FUEL HEATER CONTROL
FUEL INTERCONNECT AND CROSSFEED VALVES
FUEL VALVE
FORCE TRIM
GENERATORS NO. 1 AND NO. 2 RESET
GOVERNOR CONTROL
GUN POD INBD
GUN POD OUTBD
GUNNER WING STORES JETTISON
HYDRAULIC CONTROL (AND TEST)
ICS GUNNER
ICS PILOT
IDLE STOP SOLENOID
IFF TRANSPONDER APX-72
IFF TRANSPONDER TEST APX-72
INVERTER CONTROL RELAY
MANUAL GOVERNOR
INVERTER STANDBY POWER
MASTER CAUTION LIGHT
NAVIGATION LIGHTS
OVERSPEED GOVERNOR
PILOT AND GUNNER CONSOLE LIGHTS
PILOT AND GUNNER INSTRUMENT LIGHTS
PILOT WING STORES JETTISON
PITOT HEATER
RADAR ALTIMETER, APN-171
RADAR BEACON, APN-154
RADAR WARNING SYSTEM, APR-39 NEW
RATE GYRO (TURN AND SLIP)
ROCKET POWER
ROTOR BRAKE LIGHT
RPM CAUTION
SCAS POWER
SEARCHLIGHT CONTROL
SEARCHLIGHT POWER
SMOKE GRENADES
TMS POWER
TRANSMISSION CHIP LIGHT PANEL
TRIPLE TACHOMETER
TURRET ELEVATION STOW
TURRET BUS CONTROL
UHF KY-28
VENT BLOWER
UHF RADIO
WEAPONS CONTROL
WEAPON FIRE
WING STORES JETTISON
WING STORES POWER

N2/83
210475—12

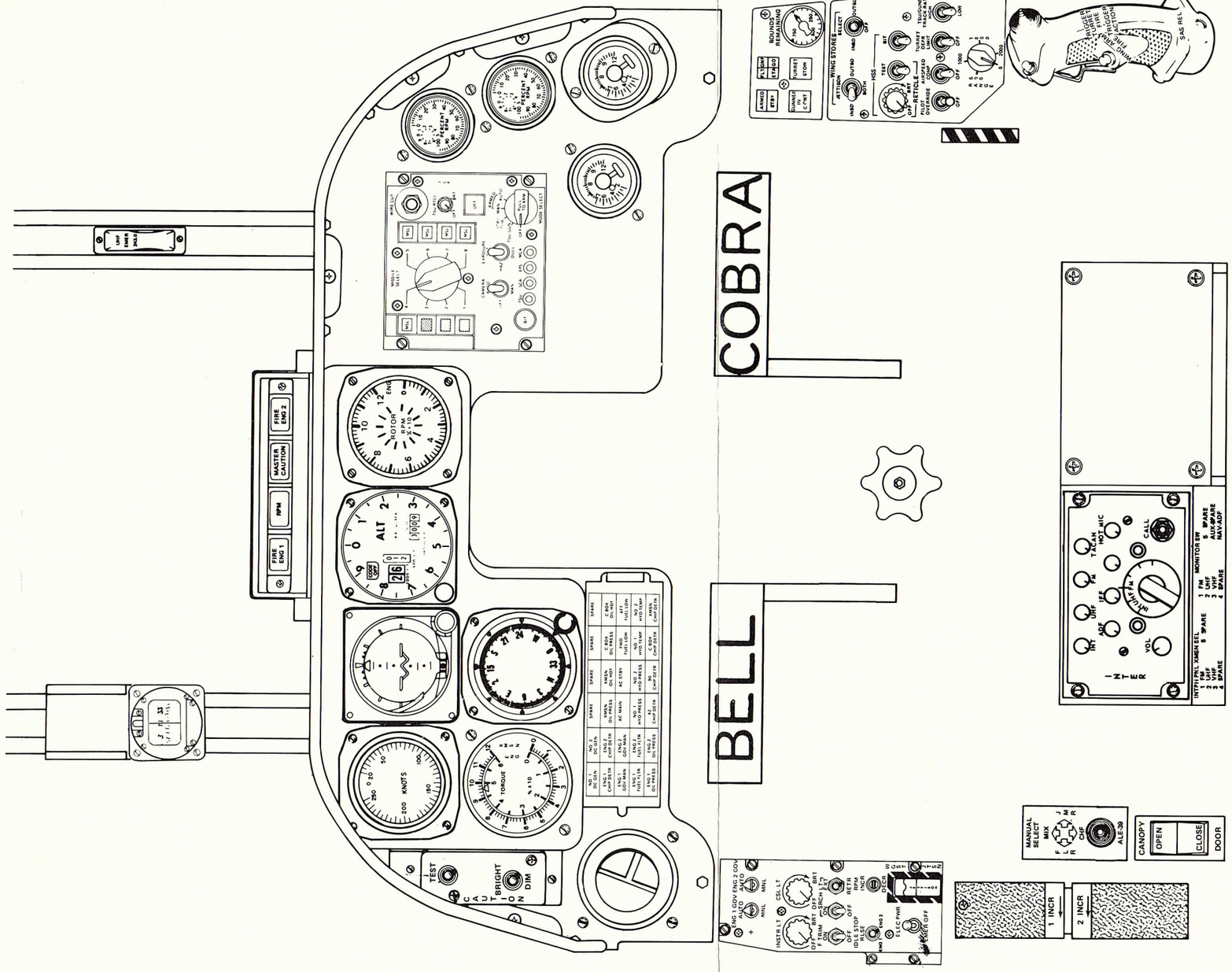

BELL
COBRA
NEW NEW NEW NEW NEW NEW
NEW
ROTOR BRAKE
COLLECTIVE TIEDOWN STRAP

FO-6. Pilot Cockpit Diagram

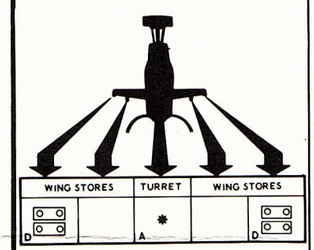


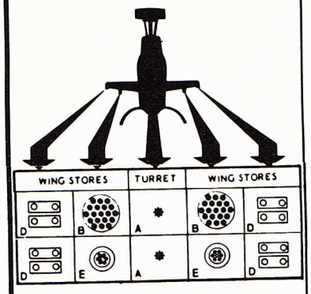
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FO-7. Copilot/Gunner Cockpit Diagram

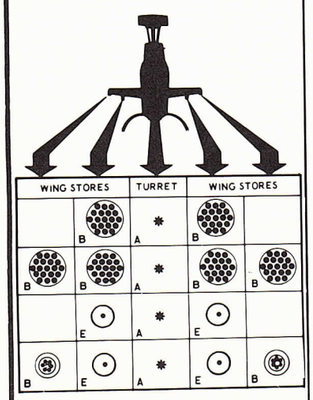


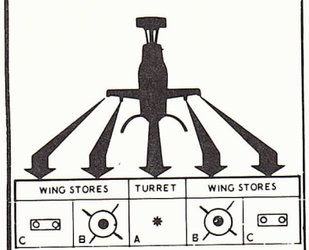
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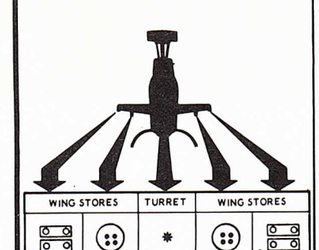
ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	ST CONT	THUMB WHEEL BOMB ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR			OFF		OFF			Gnr		Tur		HS	LHG
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
								TRK		Gnr		Tur		TSU	LHG
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							STBY TOW	STOW			Plt	Tur		HS	Cyc
								TRK			Plt	Tur		HS	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							ARMED	STOW			Plt	Tur		HS	Cyc
								TRK		Gnr		TOW		TSU	LHG
											Plt	Tur		HS	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
		PLT			OFF						Plt	Tur		HS	Cyc
		FIXED			OFF						Plt	Tur		Reflex	Cyc
					OVRD					Gnr		Tur		HS	Cyc

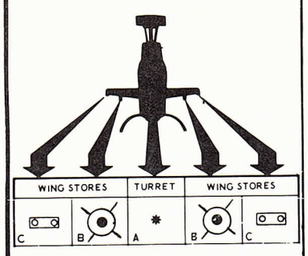
ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	ST CONT	THUMB WHEEL BOMB ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR	2/3 SEL		OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
								TRK		Gnr		Tur		TSU	LHG
											Plt	Inbd		Reflex	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							STBY TOW	STOW			Plt	Tur		HS	Cyc
								TRK			Plt	Tur		HS	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							ARMED	STOW			Plt	Tur		HS	Cyc
								TRK		Gnr		TOW		TSU	LHG
											Plt	Tur		HS	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
		PLT	2/3 SEL		OFF						Plt	Tur		HS	Cyc

	FIXED	2/3 SEL		OFF						Plt	Tur		Reflex	Cyc
											Inbd		Reflex	Cyc
				OVRD	INBD				Gnr		Tur		HS	Cyc
											Inbd		None	Cyc

ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	ST CONT	THUMB WHEEL BOMB ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR	1/2/3/4 SEL		OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Ws		Reflex	Cyc
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Ws		Reflex	Cyc
								TRK		Gnr		Tur		TSU	LHG
											Plt	Ws		Reflex	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							STBY TOW				Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
							ARMED				Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
		PLT	1/2/3/4 SEL		OFF						Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
		FIXED	1/2//3/4 SEL		OFF						Plt	Tur		Reflex	Cyc
												Ws		Reflex	Cyc
					OVRD	INBD/ OUTBD				Gnr		Tur		HS	Cyc
												Ws		None	Cyc

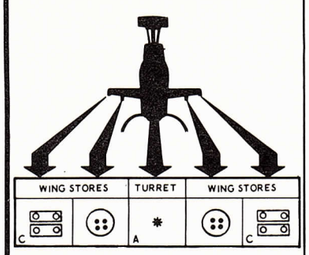
ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	ST CONT	BOMB NOSE/ TAIL/ BOTH	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR	1/2/3/4 SEL	ARM	OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
												Smk		None	Coll
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
												Smk		None	Coll
								TRK		Gnr		Tur		TSU	LHG
											Plt	Inbd		Reflex	Cyc
												Smk		None	Coll
								ACQ		Gnr			Acq	HS	
											Plt	Smk		None	Coll
								TRK	Press		Plt	Smk		None	Coll
													Acq	HS	
							STBY TOW OR ARMED				Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
												Smk		None	Coll
		PLT	1/2/3/4 SEL	ARM	OFF						Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
												Smk		None	Coll
		FIXED	1/2/3/4 SEL	ARM	OFF						Plt	Tur		Reflex	Cyc
												Inbd		Reflex	Cyc
												Smk		None	Coll
	STBY		1/4 SEL	ARM							Plt	Smk		None	Coll
					OVRD	INBD				Gnr		Tur		HS	Cyc
												Inbd		None	Cyc

ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	ST CONT	FLARE	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR	1/4 SEL	ARM	OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Smk		None	Coll
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Smk		None	Coll
								TRK		Gnr		Tur		TSU	LHG
											Plt	Smk		None	Coll
								ACQ		Gnr			Acq	HS	
											Plt	Smk		None	Coll
								TRK	Press		Plt		Acq	HS	
												Smk		None	Coll
							STBY TOW				Plt	Tur		HS	Cyc
												Smk		None	Coll
							ARMED				Plt	Tur		HS	Cyc
												Smk		None	Coll
		Plt	1/4 SEL	ARM	OFF						Plt	Tur		HS	Cyc



PILOT SWITCHES				GUNNER SWITCHES							CAN		USING	
MASTER ARM	WPN CONT	ST CONT	FLARE	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ	GUNNER	PILOT	FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
ARM	GNR	1/2/3/4 SEL	ARM	OFF		OFF			Gnr		Tur		HS	LHG
										Plt	Inbd		Reflex	Cyc
											Smk		None	Coll
						TSU/ GUN	STOW		Gnr		Tur		HS	LHG
										Plt	Inbd		Reflex	Cyc
											Smk		None	Coll
							TRK		Gnr		Tur		TSU	LHG
										Plt	Inbd		Reflex	Cyc
											Smk		None	Coll
							ACQ		Gnr			Acq	HS	
										Plt	Smk		None	Coll
							TRK	Press		Plt	Smk		None	Coll
												Acq	HS	
						STBY TOW OR ARMED				Plt	Tur		HS	Cyc
											Inbd		Reflex	Cyc
											Smk		None	Coll
	PLT	1/2/3/4 SEL	ARM	OFF						Plt	Tur		HS	Cyc
											Inbd		Reflex	Cyc
											Smk		None	Coll
	FIXED	1/2/3/4 SEL	ARM	OFF						Plt	Tur		Reflex	Cyc
											Inbd		Reflex	Cyc
											Smk		None	Coll
STBY		1/4 SEL	ARM							Plt	Smk		None	Coll
				OVRD	INBD				Gnr		Tur		HS	Cyc
											Inbd		None	Cyc

ARMAMENT CONFIGURATION



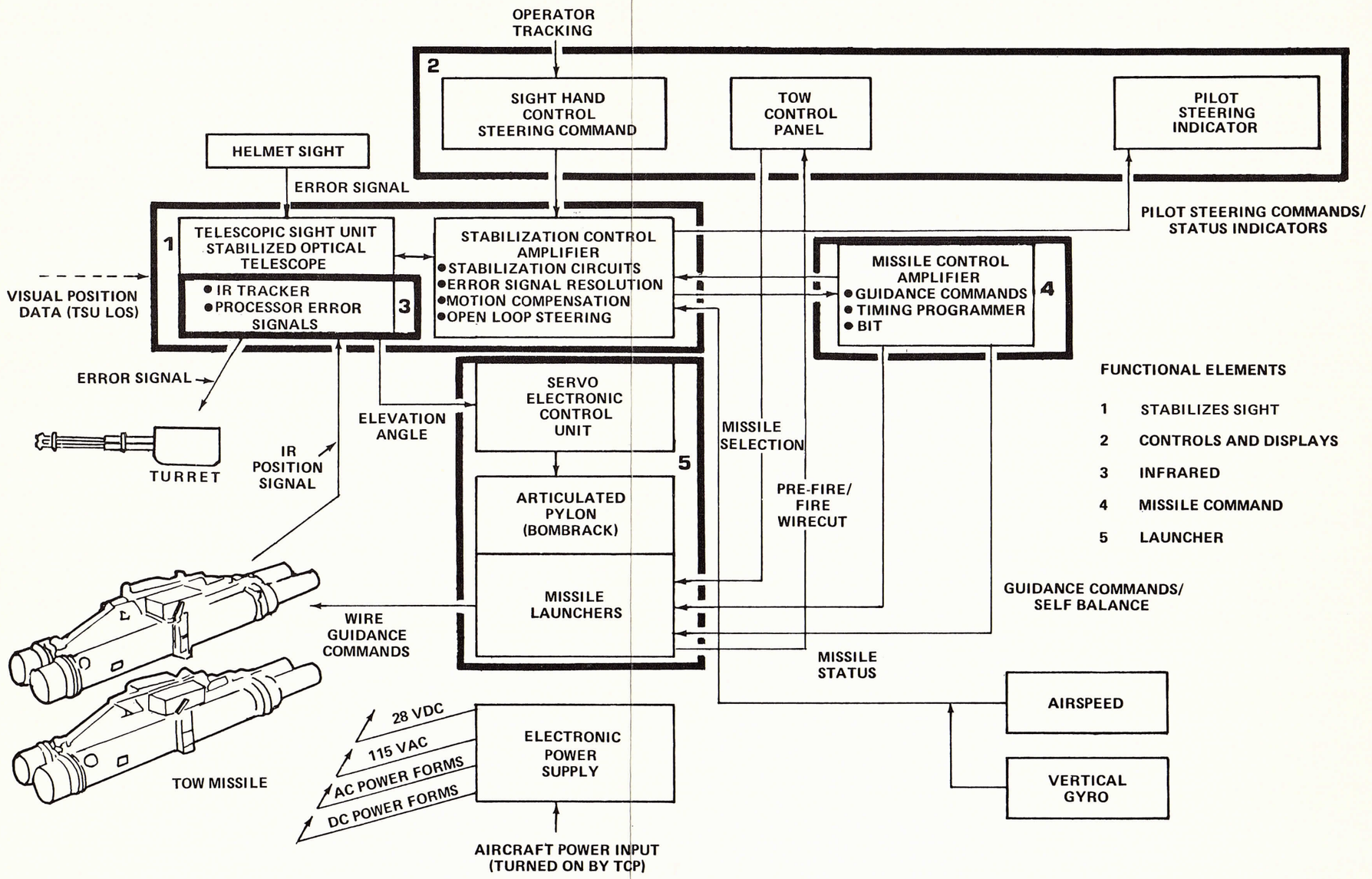
PILOT SWITCHES				GUNNER SWITCHES							CAN		USING	
MASTER ARM	WPN CONT	ST CONT	FLARE	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ	GUNNER	PILOT	FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
ARM	GNR	1/4 SEL	ARM	OFF		OFF			Gnr		Tur		HS	LHG
										Plt	Smk		None	Coll
						TSU/ GUN	STOW		Gnr		Tur		HS	LHG
										Plt	Smk		None	Coll
							TRK		Gnr		Tur		TSU	LHG
										Plt	Smk		None	Coll
							ACQ		Gnr			Acq	HS	
										Plt	Smk		None	Coll
							TRK	Press		Plt		Acq	HS	
											Smk		None	Coll
						STBY TOW				Plt	Tur		HS	Cyc
											Smk		None	Coll
						ARMED				Plt	Tur		HS	Cyc
											Smk		None	Coll
	Plt	1/4 SEL	ARM	OFF						Plt	Tur		HS	Cyc
											Smk		None	Coll
	FIXED	1/4 SEL	ARM	OFF						Plt	Tur		Reflex	Cyc
											Smk		None	Coll
STBY		1/4 SEL	ARM	OFF						PLT	Smk		None	Coll
				OVRD					Gnr		Tur		HS	Cyc

210071-35

FO-8
Reverse blank

NAVAIR 01-H1AAB-1

FO-8. Interrelation of Armament


OPERATOR TRACKING
2
SIGHT HAND CONTROL STEERING COMMAND
TOW CONTROL PANEL
PILOT STEERING INDICATOR
HELMET SIGHT
ERROR SIGNAL
PILOT STEERING COMMANDS/ STATUS INDICATORS
1
TELESCOPIC SIGHT UNIT STABILIZED OPTICAL TELESCOPE
STABILIZATION CONTROL AMPLIFIER
● STABILIZATION CIRCUITS
● ERROR SIGNAL RESOLUTION
● MOTION COMPENSATION
● OPEN LOOP STEERING
MISSILE CONTROL AMPLIFIER
● GUIDANCE COMMANDS
● TIMING PROGRAMMER
● BIT
4
VISUAL POSITION DATA (TSU LOS)
● IR TRACKER
● PROCESSOR ERROR SIGNALS
3
ERROR SIGNAL
SERVO ELECTRONIC CONTROL UNIT
ELEVATION ANGLE
MISSILE SELECTION
5
TURRET
IR POSITION SIGNAL
ARTICULATED PYLON (BOMBRACK)
PRE-FIRE/ FIRE WIRECUT
MISSILE LAUNCHERS
GUIDANCE COMMANDS/ SELF BALANCE
WIRE GUIDANCE COMMANDS
MISSILE STATUS
TOW MISSILE
28 VDC
115 VAC
AC POWER FORMS
DC POWER FORMS
ELECTRONIC POWER SUPPLY
AIRSPEED
VERTICAL GYRO
AIRCRAFT POWER INPUT (TURNED ON BY TCP)
FUNCTIONAL ELEMENTS
1 STABILIZES SIGHT
2 CONTROLS AND DISPLAYS
3 INFRARED
4 MISSILE COMMAND
5 LAUNCHER